HL7 FHIR provides a rich set of realization options for complex medical data models but does not mandate a unique realization in every case. The FAIR principles are also vague on many points to ensure broad validity.

The goal of this Implementation Guide is to develop best practices for implementing the FAIR principles when HL7 FHIR is used. In doing this, two main implementation cases should be considered:

1. **Native HL7 FHIR architectures aiming at being FAIR**.
2. **Non-native HL7 FHIR architectures supposed to be FAIRified by using HL7 FHIR.** This may be further classified considering (a) pure HL7 FHIR based solution or (b) hybrid solution (i.e., FHIR and non-FHIR)

In the first case, i.e., a native FHIR solution, it is reasonable to assume that by design:

1. A FAIR data object is a FHIR resource.
2. There are no expectations on data and metadata separation, or on data object representing collection of data, that go beyond what the current FHIR resources provides. In fact, there are FHIR resources as Citation, Library, Provenance, or others that may play the role of metadata data object; but in general, a FHIR resource includes and refers data and metadata elements.

Design assumptions that are not guaranteed for the second case.

This page summarizes some best practices for implementing the FAIR principles for the case of Native HL7 FHIR solutions.

A simple example would be FAIR's requirement for a unique, universally valid and stable identifier for each FAIR data object, in this case each individual FHIR resource instance, such as a single patient resource. The HL7 FHIR standard provides for various identifier references, some of which are technical and some of which are business identifiers. For business identifiers local (e.g. a patient number assigned by an hospital) or global identifiers (e.g. DOI) can be used; and different technologies can be adopted (e.g. OID, URI, UUID). This guide will describe what is the most appropriate identification approach to be adopted to fulfill this identification requirement.

### Findability

#### F1: (Meta) data are assigned globally unique and persistent identifiers.

The first and arguably most important FAIR principles is that [F1](https://www.go-fair.org/fair-principles/f1-meta-data-assigned-globally-unique-persistent-identifiers/): "(Meta) data are assigned globally unique and persistent identifiers". In practice, often another property of identifiers is added, namely resolvability, meaning that the identifier doubles as a link to a location which can be used to retrieve the (meta)data.

When medical data is exposed as HL7 FHIR Resources, then automatically, per the base [Resource](https://www.hl7.org/fhir/resource.html) type, the resource will have a 'logical' [id](https://www.hl7.org/fhir/resource-definitions.html#Resource.id) which serves – in a RESTful architecture - as a URL for the resource. The description also states that "Once assigned, this value never changes", so we can consider this identifier to be persistent per its specification. When combined with the URL prefix for the HL7 FHIR server, a globally unique and also resolvable identifier can be constructed, e.g. here are two GUPRIs (globally unique and persistent identifiers) for example Patient records from FHIR test servers: <http://test.fhir.org/r4/Patient/10> and <https://server.fire.ly/Patient/3591a18b-3eeb-4551-9688-22794aaf9911> (see <https://server.fire.ly/Patient> for context). Both resolve to a description of the resource, the first to a web page describing the resource, the second leads to a direct download of an XML document which describes this resource. However, if the URL at which the FHIR resource server is hosted changes, or if resources are copied to a different server, all the identifiers thus constructed would change as well. It is therefore advisable to designate a permanent namespace for prefixing the resources and assigning a persistent ['business' identifier](https://www.hl7.org/fhir/resource.html#identifiers) within that namespace. This identifier can be saved in the resource record using the [Identifier](https://www.hl7.org/fhir/datatypes.html#Identifier) type, which can hold both the namespace (using [Identifier.system](https://www.hl7.org/fhir/datatypes-definitions.html#Identifier.system)) and the identifier itself (using [Identifier.value](https://www.hl7.org/fhir/datatypes-definitions.html#Identifier.value)).

The URI that can be constructed using a concatenation of the system and value fields of the identifier is the actual URI that should be used as GUPRI for the resource, also referred to as the '[canonical URL](https://www.hl7.org/fhir/resource.html#canonical)'.

**Summary recommendation**: use the identifier field (present in most key resources and of type [Identifier](https://build.fhir.org/datatypes.html#Identifier)) to assign GUPRIs (globally unique and persistent identifiers) to any FHIR resources to adhere to FAIR principle F1. The identifier namespace (e.g. https://doi.org) goes into the [Identifier.system](https://www.hl7.org/fhir/datatypes-definitions.html" \l "Identifier.system) field, and the actual concept identifier (e.g. 10.5281/zenodo.4474373) into [Identifier.value](https://www.hl7.org/fhir/datatypes-definitions.html#Identifier.value).

#### F2: Data are described with rich metadata (defined by R1)

All HL7 FHIR Resources derive from the base Resource type, and therefore have by default a set of standard metadata fields. Specifically, there is the [Meta](https://www.hl7.org/fhir/resource-definitions.html#Resource.meta) field which has the versionId, lastUpdated, source and profile, security and tags fields. So this provides a good starting point, but most of these fields are technical in nature (['intrinsic'](https://www.go-fair.org/fair-principles/f2-data-described-rich-metadata/) metadata) and apart from profile do not really address the context of the data provided in the resource. The Meta field is not mandatory, but it is advised to at least populate the versionId and lastUpdated fields.

Moreover, each resource is a collection of elements describing the data and the context in which this data has been generated and exists (metadata) and that can be used for searches.

The adoption of FHIR can therefore enable the documentation of metadata but claiming the conformance with FHIR is not a sufficient condition for fulfilling this requirement. Whether metadata is 'rich' enough would really depend on what users would need to search on in terms of metadata fields to find the resources.

Therefore, it would make sense to look for specific Implementation Guides that cover the Resource type and use case in question, and check whether the resource indeed has the (meta)data fields needed to satisfy this findability principle in that use case.

**Summary recommendation**: Communities should define however what is meant with "rich" metadata, formalizing them with FHIR conformance resources and implementation guides.

#### F3: Metadata clearly and explicitly include the identifier of the data it describes.

*< to be revised>*

If the recommendation under F1 is followed, the resulting identifier should always be included in any resource record that holds data for the resource in question. For instance, if a medication order is represented using a [MedicationRequest](https://www.hl7.org/fhir/medicationrequest.html) as well as a [MedicationStatement](https://www.hl7.org/fhir/medicationstatement.html), both should include the same identifier (see also [resource consistency](https://www.hl7.org/fhir/resource.html#consistency)).

**Summary recommendation**:

#### F4: Metadata and data are registered or indexed in a searchable resource

In order to adhere to this principle, the FHIR [search framework](https://www.hl7.org/fhir/search.html)  can be used.

The extent of data and metadata that have to be registered or indexed would however depend on what users would need to search on to find the resources.

Most FHIR servers implement one or more search parameters, so by publishing resources into such a FHIR server may be sufficient to fulfill the FAIR principle F4 but this might not be enough.

Therefore, it would make sense to look for specific FHIR Conformance resources and/or Implementation Guides that describe the metadata and data elements that shall or should be provided to a FHIR server for the use case in question and registered or indexed by that server.

HL7 FHIR CapabilityStatement, SearchParameter, StructureDefiniton , possibly documented within a Implementation Guide should be used to document this.

**Summary recommendation:** Communities should define what are the metadata and data that have to be registered or indexed by a FHIR server for each supported resource to fulfil this principle; formalizing them with FHIR conformance resources and implementation guides.

### Accessibility

A1: Metadata and data are retrievable by each of their identifiers using a standardised communication protocol

A1.1: The protocol is open, free and universally implementable

A1.2: The protocol allows for an authentication and authorisation, where necessary

A2: Metadata should be accessible even when the data is no longer available

### Interoperability

I1: Metadata and data use a formal, accessible, shared, and broadly applicable language for knowledge representation

I2: Metadata and data use vocabularies that follow the FAIR principles

I3: Metadata and data include qualified references to other metadata and data

### Reusability

R1: Metadata and data are richly described with a plurality of accurate and relevant attributes

R1.1: Metadata and data are released with a clear and accessible data usage license

R1.2: Metadata and data are associated with detailed provenance

R1.3: Metadata and data meet domain-relevant community standards