### Making Terminologies FAIR

The FAIR principles have recently been applied to a vocabulary by Cox et al 2021 (<https://doi.org/10.1371/journal.pcbi.1009041>). This is summaried as follows (adapted from Table 1):

Findability

* Each vocabulary is denoted by a global, unique, persistent and machine resolvable identifier (GUPRI)
* Each term is denoted by a GUPRI
* It is possible to search for a term or vocabulary and get a GUPRI for it
* The vocabulary is available from at least one repository recognised by the community

Accessibility

* When the vocabulary or tem identifier is de-referenced, a machine or human readable representation is returned as returned, as requested

Interoperability

* At least one representation conforms to a community standard for vocabularies. The vocabulary includes mapping relations to other vocabularies.

Reusability

* The license for use of the vocabulary is clear, accessible and denoted by a GUPRI
* Enough metadata at vocabulary and term levels is provided to include provenance and maintenance information
* The definitions are sufficient for a user to understand what each term mean

Based on this summary of criteria for a FAIR vocabulary, Cox et al propose a set of ten simple rules (or steps of a workflow process) to transform a legacy vocabulary into a FAIR vocabulary. This can be used to provide unambiguous annotation of data which increases interoperability and enables data integration. The ten simple rules are described by these authors in detail and applied to Simple Knowledge Organisation System (SKOS) and Web Ontology Language (OWL) with examples.

### Selection of Terminologies

There are many terminologies and ontologies available via public repositories such as the NBCO BioPortal ([https://bioportal.bioontology.org](https://bioportal.bioontology.org/)) and Ontology Lookup Service, OLS (<https://www.ebi.ac.uk/ols/index>). In addition, they are also available directly from the terminology or ontology providers e.g. SNOMED CT, MeDRA amd LOINC. Selection of terminologies and ontologies can be difficult which can be informed by simple rules such as Malone et al 2016 (<https://doi.org/10.1371/journal.pcbi.1004743>).

### **Using Terminologies in FHIR**

Many elements in FHIR have a coded value, such as "gender" in the Patient resource or "bodySite" in the Observation resource. These codes are part of a code system that can be defined at different places (see [FHIR Terminology](https://www.hl7.org/fhir/terminologies.html)):

* A set of fixed values from the FHIR specification (e.g. in the case of administrative gender this can be one out of four [values](https://www.hl7.org/fhir/codesystem-administrative-gender.html), namely "male", "female", "other", or "unknown")
* A code from included in a Request for Comments (RFC) from the Internet Engineering Task Force (e.g. MIME types)
* An HL7 specification (e.g. HL7 v2)
* A dictionary, look up table, or enumeration that is locally maintained and defined by an application
* An external terminology or ontology (e.g. SNOMED CT or LOINC)

In the context of this IG, we focus on the external terminologies or ontologies. Implementing FAIR requires the use of terminologies (now referred to as code systems to follow the FHIR terminology) that are themselves FAIR-compliant. To assure FAIRness, the code system should, whenever defining a Code Pair in FHIR, follow the ten rules as described above. The FHIR specification describes how to select code systems in section 4.1.2 of the Terminology page (<https://www.hl7.org/fhir/terminologies.html#system>) and the recommendations given here are an addition to what is mentioned on that page.