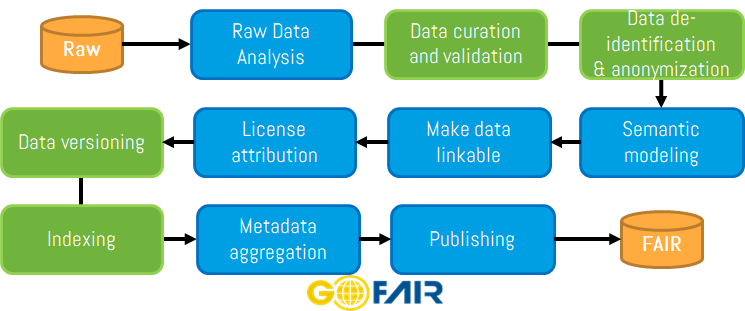
[FAIR4Health](https://www.fair4health.eu/) is a project funded by the European Union H2020 Science with and for Society (SwafS-04-2018) call for proposals. It is carried out by 17 partners from 11 different countries and lasts 36 months, bringing together expertise from different domains (health research, data managers, medical informatics, software developers, standards and lawyers).

The overall objective of FAIR4Health is to facilitate and encourage European Union Health Research community to FAIRify, share and reuse their datasets derived from publicly funded research initiatives through the demonstration of the potential impact that such a strategy will have on health outcomes and health and social care research.

### **FAIRification workflow**

In FAIR4Health Project, a FAIRification workflow, based on GO FAIR initiative, has been developed by including new steps, because we have addressed the ethical, legal and technical aspects that health data includes due to its nature. More info [here](https://pubmed.ncbi.nlm.nih.gov/32620019/).

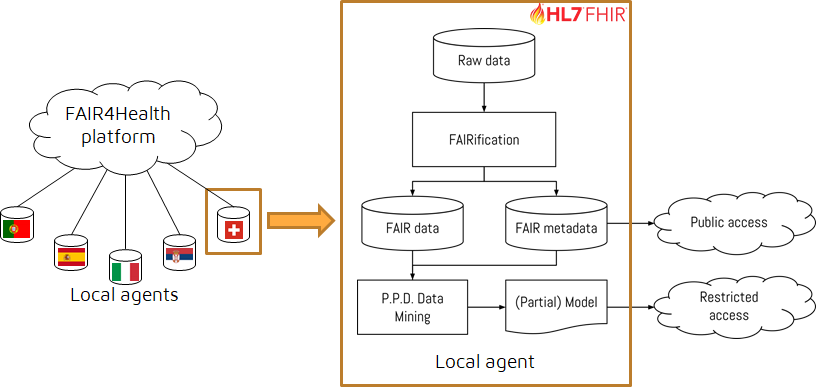


### **Solution**

The FAIR4Health core architecture is based on a [HL7 FHIR Repository](https://onfhir.io/) with a [Common Data Model](https://github.com/fair4health/common-data-model), and the implementation of the steps of the FAIRification workflow. Two open-source software components, based on the use of the HL7 FHIR  standard, have been developed to obtain FAIR data from raw data resulting from health research:

* [Data Curation Tool](https://github.com/fair4health/data-curation-tool) is a highly specialized Extract-Transform-Load tool which can extract data from relational databases and spreadsheets, applies user-defined transformations and then loads the transformed resources into an HL7 FHIR repository. [Video tutorial](https://www.youtube.com/watch?v=S93iqD4XxMM).
* [Data Privacy Tool](https://github.com/fair4health/data-privacy-tool) is responsible for handling the privacy challenges on sensitive health data by applying several data de-identification and anonymization techniques. After the curation process is finished, the Data Manager uses the Data Privacy Tool to de-identify data before making it available to other systems/components as FAIR data. This tool reads and writes de-identified and anonymized resources back to the HL7 FHIR repository. [Video tutorial](https://www.youtube.com/watch?v=sWzUv1RNSvI).

On top of these, FAIR4Health has implemented a privacy-preserving distributed data mining (PPDDM) framework enabling health research organizations to perform joint data mining operations without exposing any sensitive patient information to the outside world.



This solution uses HL7 FHIR in the sense defined in this IG. The kind of resources included in "Healthcare datasets" section > "EXAMPLES" subsection, are generated by the Data Curation Tool, are updated by the Data Privacy Tool, and are used by the PPDDM framework.

### **Use cases**

To validate the FAIR4Health solution, two use cases has been defined, with the aim to demonstrate the sharing and reuse of FAIRifed data through the PDDDM framework:

1. Identification of multimorbidity patterns and polypharmacy correlation on the risk of mortality in elderly.
2. Early prediction service for 30-days readmission risk in COPD patients.

The main objective of the pathfinder case study #1 is to characterize the existence of associations between chronic diseases, and its impact, together with polypharmacy on 6-month mortality rate and cognitive impairment. As a result, a multicentric observational study has been designed in which data is collected from 7 different European cohorts. The population studied consisted of individuals aged 65 years or older with at least two chronic diseases. In the study, 5 health institutions across Europe participate: (i) Andalusian Health Service, Spain; (ii) Aragon Health Sciences Institute, Spain; (iii) Geneva University Hospitals, Switzerland; (iv) University of Porto, Portugal; (v) Catholic University of the Sacred Heart, Italy.

On the other hand, Chronic Obstructive Pulmonary Disease (COPD) is one of the most prevalent chronic diseases. It has been associated with high morbidity and mortality, as well as a high rate of readmission. The pathfinder case study #2 has three different phases, the first is the development of a multicentric retrospective study in which the rate of readmission of COPD patients within 30 days after hospital discharge is analyzed. In addition, the demographic, functional and healthcare characteristics of patients fitting the above description are described. The second phase allows the development of an early 30-days hospital readmission risk prediction assessment tool. And, finally, an observational study with 30-day follow-up aims to evaluate the impact of this tool on health by collecting data from a selected sample of subjects. The data gathered is compared with a retrospective cohort of cases meeting the same inclusion/exclusion criteria. The population studied consists of individuals over the age of 65 with a diagnosis of COPD who have been admitted to the hospital for this disease. In the study, 5 health institutions across Europe participate: (i) Andalusian Health Service, Spain; (ii) Aragon Health Sciences Institute, Spain; (iii) Geneva University Hospitals, Switzerland; (iv) Catholic University of the Sacred Heart, Italy; (v) Institute for Pulmonary Diseases of Vojvodina, Serbia.

FAIR4Health is funded by the European Union's Horizon 2020 research and innovation programme under Grant Agreement number 824666.

### REFERENCE PROFILES

please, to develop this subsection, could you give me some details of the F4H profile we uses in the DCT and DPT?

* Is it one profile (shared for both tools), two profiles (one by tool), or several profiles (one by FHIR Resource used by both tools)?
* Are this/these profile(s) open source? (if yes, please, could you inform me the link?)
* Are the F4H profile based on a FHIR reference profile? (if yes, please, could you inform me the link? maybe [*this*](http://www.hl7.org/Fhir/reference.profile.json.html)? )

Thank you in advance.

This proposed use of HL7 FHIR has been technically implemented in a profile.  [TBC: To Be Completed]

### EXPECTED OUTCOMES (EXAMPLES OF USE)

Below, an example of HL7 FHIR use has been included:

#### HL7 FHIR Patient Resource

{

"fullUrl":"http://SERVER\_IP/fhir/Patient/Pe60e6adc5a7e6e9ede36ad27eedcb7e",

"resource":{

"resourceType":"Patient",

"id":"Pe60e6adc5a7e6e9ede36ad27eedcb7e",

"meta":{

"profile":[ "http://hl7.eu/fhir/f4h/StructureDefinition/Patient-eu-f4h" ],

"versionId":"2",

"lastUpdated":"2021-05-27T12:07:57.646Z"

},

"identifier":[ {

"system":"http://hl7.eu/fhir/sas-patient",

"value":"AN0123456789"

} ],

"gender":"female",

"birthDate":"1956-12-06",

"address":[ {

"country":"724"

} ]

},

"search":{

"mode":"match"

}

}

#### HL7 FHIR Encounter Resource

{

"fullUrl":"http://SERVER\_IP/fhir/Encounter/E646be04e617e7566f71e8466f0ccacf",

"resource":{

"resourceType":"Encounter",

"id":"E646be04e617e7566f71e8466f0ccacf",

"meta":{

"profile":[ "http://hl7.eu/fhir/f4h/StructureDefinition/Encounter-eu-f4h" ],

"versionId":"1",

"lastUpdated":"2021-05-27T11:43:43.502Z"

},

"identifier":[ {

"system":"http://hl7.eu/fhir/sas-encounter",

"value":"123456789"

} ],

"status":"finished",

"class":{

"system":"http://terminology.hl7.org/CodeSystem/v3-ActCode",

"code":"IMP"

},

"type":[ {

"coding":[ {

"system":"http://hl7.eu/fhir/f4h/codesystem/f4h-encounter-type",

"code":"unplanned"

} ]

} ],

"subject":{

"reference":"Patient/Pe60e6adc5a7e6e9ede36ad27eedcb7e"

},

"period":{

"start":"2019-04-15T00:00:00.000Z",

"end":"2019-04-20T00:00:00.000Z"

}

},

"search":{

"mode":"match"

}

}

#### HL7 FHIR Condition Resource

{

"fullUrl":"http://SERVER\_IP/fhir/Condition/Cd0a6e649c6f173a6a8c7896e3a7668e9",

"resource":{

"resourceType":"Condition",

"id":"Cd0a6e649c6f173a6a8c7896e3a7668e9",

"meta":{

"profile":[ "http://hl7.eu/fhir/f4h/StructureDefinition/Condition-eu-f4h" ],

"versionId":"1",

"lastUpdated":"2021-05-27T11:43:27.943Z"

},

"identifier":[ {

"system":"http://hl7.eu/fhir/sas-condition",

"value":"123456789ABCDEFG"

} ],

"code":{

"coding":[ {

"system":"http://hl7.org/fhir/sid/icd-10",

"code":"I26.99"

} ]

},

"subject":{

"reference":"Patient/Pe60e6adc5a7e6e9ede36ad27eedcb7e"

},

"encounter":{

"reference":"Encounter/E646be04e617e7566f71e8466f0ccacf"

},

"onsetDateTime":"2019-12-19T00:00:00.000Z"

},

"search":{

"mode":"match"

}

}

#### HL7 FHIR MedicationStatement Resource

{

"fullUrl":"http://SERVER\_IP/fhir/MedicationStatement/Maee5bee6fa22198a668ee3abc336e6f",

"resource":{

"resourceType":"MedicationStatement",

"id":"Maee5bee6fa22198a668ee3abc336e6f",

"meta":{

"profile":[ "http://hl7.eu/fhir/f4h/StructureDefinition/MedicationStatement-eu-f4h" ],

"versionId":"2",

"lastUpdated":"2021-05-27T12:07:20.134Z"

},

"identifier":[ {

"system":"http://hl7.eu/fhir/sas-medication",

"value":"123456789ABCDEFG\_M"

} ],

"status":"unknown",

"medicationCodeableConcept":{

"coding":[ {

"system":"http://www.whocc.no/atc",

"code":"CO9A"

} ]

},

"subject":{

"reference":"Patient/Pe60e6adc5a7e6e9ede36ad27eedcb7e"

},

"context":{

"reference":"Encounter/E646be04e617e7566f71e8466f0ccacf"

},

"effectiveDateTime":"2018-08-14T00:00:00.000Z"

},

"search":{

"mode":"match"

}

}

#### HL7 FHIR Observation Resource

{

"fullUrl":"http://SERVER\_IP/fhir/Observation/Of3a110a6e6f665e9030eec696d8cf2e",

"resource":{

"resourceType":"Observation",

"id":"Of3a110a6e6f665e9030eec696d8cf2e",

"meta":{

"profile":[ "http://hl7.eu/fhir/f4h/StructureDefinition/Observation-lab-eu-f4h" ],

"versionId":"1",

"lastUpdated":"2021-05-27T11:44:05.578Z"

},

"identifier":[ {

"system":"http://hl7.eu/fhir/sas-labtest",

"value":"1234567890\_1234"

} ],

"status":"final",

"code":{

"coding":[ {

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

"code":"2160-0"

} ]

},

"subject":{

"reference":"Patient/Pe60e6adc5a7e6e9ede36ad27eedcb7e"

},

"encounter":{

"reference":"Encounter/E646be04e617e7566f71e8466f0ccacf"

},

"effectiveDateTime":"2016-02-10T00:00:00.000Z",

"valueQuantity":{

"value":92.04,

"unit":"mg/dl",

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

"code":"mg/dl"

}

},

"search":{

"mode":"match"

}

}

### ****FAIRness Assessment****

Description of the main findings and gaps

To analyze the FAIRness level, the [RDA FAIR Data Maturity Model guidelines](https://doi.org/10.15497/RDA00050) has been applied.

[[In progress [here](https://docs.google.com/spreadsheets/d/1IeiBSbDScSTgOJzB-pKZKSHUBPsS4qdg/edit#gid=157819900)]]

[TBC: To Be Completed]