Linking biobanks with public data using Bioschemas: Meeting Notes form the EMBL-EBI hackathon held on 15th and 16th of March 2018 at EMBL-EBI Hinxton



Summary of the meeting:

Action Items

Meeting Notes
- Discussion Session 1: Biobanks use cases
  - Use case 1: Finding a tissue bank with the required sample (find a sample set)
  - Use case 2: rare disease use case - Finding individual samples
  - Use case 3: linking sample collections or samples to data
- Discussion Session 2: Mapping to bioschemas
  - Use case 1
    - DataRecord
    - Organization - Biobank
    - Glue DataRecord with Data Catalog
    - Example with links to resources
  - Use case 2
- MIABIS mapping to Bioschemas

Real-World Examples Using Directory
- Biobank BioSchemas

DataSet to DataRecord Glue
Collection BioSchemas

Summary of the meeting:

Scope of the Hackathon was to collaborate with biobanks - specifically BBMRI-ERIC and UK TDCC - in using bioschemas profiles to expose data available in biobanks archives.

The two days hackathon was useful to understand which profiles best fit biobanks use cases on how to export their content and how remain compatible with the MIABIS standard already used by biobanks for data exchange.

Biobanks - due to their privacy model - are not able to expose single sample details.
They usually export some generic information useful to identify group/set of samples of interest within the biobanks, but not specific sample details - which remain inside the biobanks and accessible only through the biobank itself after acceptance of terms of agreement.
Differently from regular biobanks, the rare disease biobanks, due to the specificity of the disease and the lack of data generally available for those samples, samples metadata are exposed "in toto".

Outcome of the meeting were:

1. Discussion on mapping between MIABIS standard and bioschemas profiles, which are compatible at some degree
2. Definition of use cases for exporting metadata using bioschemas [1,2,3]
3. Agreement on the adoption of Organisation, DataCalaog and DataRecord profiles in Bioschemas
4. Agreement on the adoption of the Sample profile do export rare disease samples
5. Relevance of CategoryCode profile to enrich PropertyValues even outside of the Sample Profile

Action Items

1. Email attendees links to documents and summary of meeting notes with action items. Next week.

2. Produce some example to put on bioschemas.org. Matt and Luca to get timelines and chase up examples by the very latest end of March.

- Petr: to produce an example of use case no1 using the proposed mapping between MIABIS and schema.org for BBMRI-ERIC
- Matt and Luca: to produce an example of bioschemas sample spec with a rare disease example (from the rare disease directory)
- Matt Styles: to produce examples from the UK tissue directory using the proposed mapping between MIABIS and schema.org
- Federico: to produce examples for IMPC mice samples using the current sample profile.
- Leyla to ask Olga how the lab protocol

3. Updates to bioschemas

- Matt and Luca: Update the proposal for CategoryCode and extend it to every PropertyValue, this includes also the DataRecord (create a github issue with this and tag Ricardo)

4. Matt and Luca to coordinate with Petr to produce guidance that documents the profile's application to biobanks use cases. Including information such as why the biobank has been split into Organization and DataCatalog.

5. Matt and Luca to discuss with the bioschemas community if Bioschemas should provide a SampleDataRecord profile ~~on top of the suggested already type (NB it is already a type)~~

6. Continued dialogue between EBI, BBMRI-ERIC and TDCC about data linking. Discussion thus far is detailed below. No specific action items as we need a biobank to prototype this use case (no. 3) to provide us with proof on concept for others.

7. Matt and Luca to convert these action items to github issues

We need to aim to get some 'Live Deploys' of the sample spec from biobanks.

Meeting Notes

Link to the shared folder:
https://drive.google.com/drive/folders/1PVMvdJMBy9SMeH7dN235OnZAxZam6s21

Bioschemas has been organized in groups, each group started highlighting specific use cases, that are summarizable in these 4 classes:

1. Findability
2. Accessibility: gather information without the need to deal with different formats
3. Summarization:
4. Resource index

BioChemEntity is a wrapper for most of the profile proposed. In Bioschemas we try to distinguish the Entity from the Record. E.g for a protein entity we should not define a collection date, because this is a property related to the record and not with the entity.

Schema.org provides **Types,** and every property associated with a type in schema.org is optional. In Bioschemas we want to provide some guidance on which properties are recommended, minimum or optional through the **Profiles**. (Bioschemas profiles here)

Samples profile, key for the Sample record is the **external data**.

MIABIS: Minimum Information About Blobank data Sharing: Petr Holub

Some use cases from

- What sample collection and what data collection are available
- Lab protocol and the integration of the provenance
- Ontologizing MIABIS, use the MIABIS term in the additional property
- How much Bioschemas maps to the use cases of Biobank queries
- Citation of the Biobanks

Minimum Information About Biobank data Sharing. Version 2 has been splitted into components. One of them is sample and donor component

Connector component in a Biobank implements the common API to talk with a Sample locator in BBMRI-ERIC where authenticated users will be able to search for samples in the biobanks

Usually biobank' samples are private and don't necessarily want to share the metadata. But there are cases, like in the case of rare diseases, where the community wants to share the data.

Multiple component are part of the sample and donor component:

1. Person component (A person could be donor multiple times)
2. Sample component
3. Event: simple structure to describe events at different time points, e.g. sampling event, disease diagnosis event, death event, data-collection event - temporal queries

MIABIS 2.0 CORE aggregate-level data is public and is the part that probably will be shareable using bioschemas. There are other portion of the MIABIS specs that we can share using Bioschemas?

Q: What would you get from using Bioschemas with MIABIS?
Probably better findability of the data

Q: Schema.org looks more flexible than some of the profiles proposed from Bioschemas
Profiles contains just a limited amount of properties that is actually minimal. And those are derived usually from use cases

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MIABIS: Implementation by UK Biobanking: Matt Styles

UKCRC Tissue directory

Search by samples or by Biobank capability (e.g. is Biobank able to collect the sample)

Use Bioschemas in the web view to make data more accessible
Expose data about a data collection. Using Bioschemas to expose the single sample in the case of a Biobank is probably not possible for confidentiality reasons.

MarRef Bioschemas use case and demo

MarRef is a rich manually curated resource. We used the buzzbang crawler in a sandbox environment to create curation objects in BioSamples to enrich the metadata.

Buzzbang crawler demo

Discussion Session 1: Biobanks use cases

Link to MIABIS core attributes:
https://github.com/MIABIS/miabis/wiki/Data-describing-Biobank
https://github.com/MIABIS/miabis/wiki/Data-describing-Sample-Collection

Findability is going to be one of the main focuses for the biobanks

Prerequisites:
- Requirement of information on an institutional level about the general abilities of biobanks e.g. scientific facilities and data services
- N.B. Samples in biobanks are often exposed externally as sample sets with aggregated metadata for data protection purposes

Use case 1: Finding a tissue bank with the required sample (find a sample set)

N.B. also users often need to do negated searches. E.g. samples that do not have a certain disease.
It would be useful to have an additional property that annotates what standard the sample is following e.g. a specific version of MIABIS

As a **sample requester**, I would like to Identify Biobanks based on available properties of samples stored, what data associated to the sample collection is available and what the Biobank capabilities are (aggregate data) so I'll be able to get a list of Biobanks id and samples collection that match my needs
Attributes
- Diagnosis
- Material type
- General condition of use (academic vs industry)

The collection id could be represented as a DataRecord, with the mainEntity as potentially a list of all the physicalEntity (samples) that are associated to the DataRecord (the collection partition). We would use the additionalProperty of dataRecord to describe properties like material type, diagnoses, condition of use.

https://directory.bbmri-eric.eu/ (UI - main page)
https://directory.bbmri-eric.eu/menu/main/apps/aaaacyh5332kz6qwhzbobnyaai/biobankexplorer (UI - simplified search/browsing)
https://directory.bbmri-eric.eu/menu/main/dataexplorer?entity=eu_bbmri_eric_collections (advanced UI - collections)
https://directory.bbmri-eric.eu/menu/main/dataexplorer?entity=eu_bbmri_eric_collections (advanced UI - collections)
https://directory.bbmri-eric.eu/api/v2/eu_bbmri_eric_collections (REST/JSON API - collections)
https://directory.bbmri-eric.eu/api/v2/eu_bbmri_eric_biobanks (REST/JSON API - biobanks)

```
        {
        "_href":
"/api/v2/eu_bbmri_eric_collections/bbmri-eric:ID:DE_HUB:collection:TX-Kohorte",
        "age_unit": [],
        "biobank": {
                "_href": "/api/v2/eu_bbmri_eric_biobanks/bbmri-eric:ID:DE_HUB",
                "id": "bbmri-eric:ID:DE_HUB",
                "name": "Hannover Unified Biobank"
        },
        "body_part_examined": [],
        "contact": {
                "_href": "/api/v2/eu_bbmri_eric_persons/bbmri-eric:contactID:DE_HUB_Two",
                "email": "Klopp.Norman@mh-hannover.de",
                "id": "bbmri-eric:contactID:DE_HUB_Two"
        },
        "contact_priority": 1,
        "country": {
                "_href": "/api/v2/eu_bbmri_eric_countries/DE",
                "id": "DE",
                "name": "Germany"
        },
        "data_categories": [
                {
                "_href": "/api/v2/eu_bbmri_eric_data_types/BIOLOGICAL_SAMPLES",
                "id": "BIOLOGICAL_SAMPLES",
                "label": "Biological samples"
                }
        ],
        "description": "The DZIF Transplant Cohort is unique in Germany and aims to help
improve treatment of pat
ients who have already received a donor organ or had a stem cell transplant.",
        "diagnosis_available": [],
        "id": "bbmri-eric:ID:DE_HUB:collection:TX-Kohorte",
        "image_dataset_type": [],
        "imaging_modality": [],
        "materials": [
                {
                "_href": "/api/v2/eu_bbmri_eric_material_types/OTHER",
                "id": "OTHER",
                "label": "Other"
                },
                {
                "_href": "/api/v2/eu_bbmri_eric_material_types/PLASMA",
                "id": "PLASMA",
                "label": "Plasma"
                },
                {
                "_href": "/api/v2/eu_bbmri_eric_material_types/RNA",

                "label": "RNA"
                },
```

```
            {
            "_href": "/api/v2/eu_bbmri_eric_material_types/SERUM",
            "id": "SERUM",
            "label": "Serum"
            },
            {
            "_href": "/api/v2/eu_bbmri_eric_material_types/URINE",
            "id": "URINE",
            "label": "Urine"
            },
            {
            "_href": "/api/v2/eu_bbmri_eric_material_types/FECES",
            "id": "FECES",
            "label": "Feces"
            }
],
"name": "TX-Kohorte",
"network": [],
"order_of_magnitude": {
            "_href": "/api/v2/eu_bbmri_eric_biobank_size/3",
            "id": 3,
            "size": "1000 - 10.000 Samples"
},
"sex": [],
"size": 5600,
"standards": [],
"storage_temperatures": [
            {
            "_href": "/api/v2/eu_bbmri_eric_temp_types/temperature-60to-85",
            "id": "temperature-60to-85",
            "label": "-60\u00b0C to -80\u00b0C"
            },
            {
            "_href": "/api/v2/eu_bbmri_eric_temp_types/temperatureLN",
            "id": "temperatureLN",
            "label": "Liquid Nitrogen"
            }
],
"sub_collections": [],
"timestamp": "2017-08-24T22:00:00Z",
"type": [
            {
            "_href": "/api/v2/eu_bbmri_eric_collection_types/DISEASE_SPECIFIC",
            "id": "DISEASE_SPECIFIC",
            "label": "Disease specific"
            },
            {
            "_href": "/api/v2/eu_bbmri_eric_collection_types/HOSPITAL",
            "id": "HOSPITAL",
            "label": "Hospital"
            }
```

```
]
},
```


Use case 2: rare disease use case - Finding individual samples

See for example Rare disease case at
http://rd-connect.eu/biosamples-data/sample-catalogue/

As a **sample requester,** I want to search samples based on material type, diagnosis and mutations to get a list of samples of potential interest to me.

This will return a collection of DataRecord, one for each sample returned by the query

https://samples.rd-connect.eu/menu/main/dataexplorer?entity=rdconnect_Sample

https://samples.rd-connect.eu/api/v2/rdconnect_Sample


```
"items": [
{
"Affected": {
        "_href": "/api/v2/rdconnect_BoolWithNullFlavors/TRUE",
        "label": "Yes",
        "value": "TRUE"
},
"AnatomicalSite": {
        "IRI": "http://purl.obolibrary.org/obo/UBERON_0000178",
        "PreferredTerm": "Blood",
        "_href":
"/api/v2/rdconnect_AnatomicalSite/http:%2F%2Fpurl.obolibrary.org%2Fobo%2FUBERON_0000178"

},
"BiobankID": {
        "_href": "/api/v2/sys_idc_Biobank/77350",
        "name": "Galliera Genetic Bank",
        "organizationId": "77350"
},
"DiagnosisType": [
        {
        "_href": "/api/v2/rdconnect_DiagnosisType/MOLECULAR",
        "label": "Molecular",
        "value": "MOLECULAR"
        },
        {
        "_href": "/api/v2/rdconnect_DiagnosisType/CYTOGENETICS",
        "label": "Cytogenetics",
```

```
                "value": "CYTOGENETICS"
                }
        ],
        "Disease": [
                {
                "IRI": "urn:miriam:orphanet:Orphanet_1440",
                "PreferredTerm": "Ring chromosome 14",
                "_href":
"/api/v2/rdconnect_Disease/urn:miriam:orphanet:Orphanet_1440"
                }
        ],
        "Family": {
                "_href": "/api/v2/rdconnect_BoolWithNullFlavors/UNK",
                "label": "Unknown",
                "value": "UNK"
        },
```


Example catalogue (Rett syndrome):
http://catalogue.rd-connect.eu/web/rett-database-network/reg_home

Use case 3: linking sample collections or samples to data

- Data held by the biobank themselves or by public archives such as EGA
- Some links to data may require an access procedure

As tissue repository I want to inform customers if sample sets have any data associated with them.
As a customer of a tissue directory I want to know if a sample collection has any associated data so I can avoid analysis duplication and leverage other users work.

In discussion with Matt Styles:
As the researchers have an obligation to inform and share any data generated from the samples with the biobank. Therefore the biobank hold all the mapping information to link samples to data. This then needs to be shared with the tissue repository (potentially via software vendors) so that the tissue directory can expose bioschemas that link to the public data (potentially held in EGA).

https://ega-archive.org/datasets/EGAD00010001497 - Example of a case where a collection was used to submit 485000 samples to EGA. EGA knows none of the data about these samples - these are only know by UK Biobank. EGA does not currently expose sample metadata at all.

Discussion Session 2: Mapping to bioschemas

Use case 1

DataRecord

https://directory.bbmri-eric.eu/api/v2/eu_bbmri_eric_collections/bbmri-eric:ID:CZ_MMCI:collection:LTS:gDNA


```
{
   "@context": "http://schema.org",
   "@type": ["DataRecord"],
   "additionalProperty": [
      {
         "@type": "PropertyValue",
         "name": "diagnosis_available",
         "value": "urn:miriam:icd:C00-C97",
         "valueReference": [
            {
               "@type": "CategoryCode",
               "name": "Malignant neoplasms",
               "url": "http://purl.bioontology.org/ontology/ICD10/C00-C97.9",
               "codeValue": "C00-C97.9"
            }
         ]
      },
      {
         "@type": "PropertyValue",
         "name": "diagnosis_available",
         "value": "urn:miriam:icd:D00-D09",
         "valueReference": [
            {
               "@type": "CategoryCode",
               "name": "In situ neoplasms",
               "url": "http://purl.bioontology.org/ontology/ICD10/D00-D09.9",
               "codeValue": "D00-D09.9"
            }
         ]
      },
      {
         "@type": "PropertyValue",
         "name": "materials",
         "value": "DNA"
      },
```

```
      {
         "@type": "PropertyValue",
         "name": "data_categories",
         "value": "Survey data",
         "valueReference": [
            {
               "@type": "CategoryCode",
               "name": "Survey data",
               "url":
"http://www.ontobee.org/ontology/OMIABIS?iri=http://purl.obolibrary.org/obo/OMIABIS_0000
060",
               "codeValue": "OMIABIS_0000060"
            }
         ]
      }
   ]
}
```

Organization - Biobank

```
{
   "@context": "http://schema.org",
   "@type": "Organization",
   "url": "",
   "identifier": "",
   "name": "",
   "email": "",
   "address": {
      "@type": "PostalAddress",
      "contactType": "", // jurisdic person
      "telephone": "",
      "streetAddress": "",
      "postalCode": "",
      "addressLocality": "",
      "addressCountry": "",
   },
   "description": "",
   "alternateName": "", //acronym
   "legalName": ""
}
```

Glue DataRecord with Data Catalog

```
{
   "@context": "http://schema.org",
   "@type": "DataCatalog",
```

```
    "description": "",
    "keywords": "",
    "name": "",
    "url": "",
    "provider": {
        "@type": "Organization",
        //...
    },
    "dataset": [
        {
            "@type": "DataRecord",
            //...
        }
    ]
}
```

Example with links to resources

```
{
    "@context": "http://schema.org",
    "@type": "DataCatalog",
    "@id": "BioBankPID",
    "description": "",
    "keywords": "",
    "name": "",
    "url": "",
    "provider": {
        "@type": "Organization",
        //...
    },
    "dataset": [
        // Example on how to link to an external DataSet
        {
            "@id": "urlToDataSet"
        },

        // Example on how to embbed the Dataset
        {
            "@type": "DataRecord",
            "includedInDataCatalog": {"@id": "BioBankPID"},
            "mainEntity": [
                {
                    "@type": ["BioChemEntity", "Sample"],
                    "identifier": [],
                    "url": "",
                    "additionalProperty": [
```

```
            ]
         },
         {
            "@id": "urlToSample"
         }
      ]
   }
 ]
}
```


AI: Produce an example with the proposed models and send an email

Use case 2

MIABIS mapping to Bioschemas

- Data record (http://bioschemas.org/specifications/DataRecord/specification/) will be used to mark up a set of samples.
- Do we have a profile that is able to deal with phenotypes or should we use the Sample profile?
- Being able to designate what version of metadata standards a sample complies with - resolved by having an additionalProperty, e.g. ‘metadataStandardsVersion’
- Biobank directories need to describe organisation (their biobanks). This can come from schema.org. Then to link the organisation (the biobank) to the dataRecords (tissue collections themselves) using isPartOf
- *dataRecord* linked *to themselves* using isPartOf/hasPart
    - this describes hierarchy relations of collections
- *dataRecord* linked *to organisation* using isPartOf/hasPart
    - this describes anchoring the top-level collections in the biobanks
- The tissue directory is a dataRecord that has multiple biobanks (represented as organisation and data catalogue) these biobanks have multiple collections of samples (also represented as dataRecords)
- In the case of rare disease maybe individual samples are exposed. In this case we use the bioschemas sample type in the dataRecord.

Real-World Examples Using Directory

Biobank BioSchemas


```
{
  "@context" : "http://schema.org",
  "@type" : "Organization",
  "address" : {
        "@type" : "PostalAddress",
        "addressLocality" : "Brno,CZ",
        "contactType" : "juridical person",
        "streetAddress" : "Masarykův onkologický ústav Žlutý kopec 7"
  },
  "alternateName" : "MMCI",
  "description" : "Biobank at MMCI was established to preserve patient-derived specimens such as tumours and blood-derived samples . Its structure comprises of a \"long-term storage repository\" designed to store a comprehensive set of patient samples such as tumours, adjacent tissues, genomic DNA and serum at surgery, and the \"short term storage repository\" designed to store serum aliquots from periodic determination of soluble blood tumour markers.  Comprehensive clinical data are available through the hospital infromation system to enable further translational and clinical research.",
  "email" : "mmci@bbmri.cz",
  "identifier" : "bbmri-eric:ID:CZ_MMCI",
  "legalName" : "Masaryk Memorial Cancer Institute",
  "name" : "Bank of Biological Material, Masaryk Memorial Cancer Institute",
  "url" :
"https://directory.bbmri-eric.eu/menu/main/dataexplorer/details/eu_bbmri_eric_biobanks/bbmri-eric:ID:CZ_MMCI"
}
```


DataSet to DataRecord Glue


```
{
  "@context" : "http://schema.org",
  "@type" : "DataCatalog",
  "dataset" : [
        {
        "@id" : "/api/v2/eu_bbmri_eric_collections/bbmri-eric:ID:CZ_MMCI:collection:LTS",
        "@type" : "DataRecord",
        "identifier" : "bbmri-eric:ID:CZ_MMCI:collection:LTS",
        "name" : "Long Term Storage Collection",
        "url" : "/api/v2/eu_bbmri_eric_collections/bbmri-eric:ID:CZ_MMCI:collection:LTS"
```

```
        },
        {
        "@id" :
"/api/v2/eu_bbmri_eric_collections/bbmri-eric:ID:CZ_MMCI:collection:LTS:gDNA",
        "@type" : "DataRecord",
        "identifier" : "bbmri-eric:ID:CZ_MMCI:collection:LTS:gDNA",
        "name" : "Genomic DNA in Long Term Storage Collection",
        "url" :
"/api/v2/eu_bbmri_eric_collections/bbmri-eric:ID:CZ_MMCI:collection:LTS:gDNA"
        },
        {
        "@id" :
"/api/v2/eu_bbmri_eric_collections/bbmri-eric:ID:CZ_MMCI:collection:LTS:gDNA-HCS",
        "@type" : "DataRecord",
        "identifier" : "bbmri-eric:ID:CZ_MMCI:collection:LTS:gDNA-HCS",
        "name" : "Genomic DNA in Long Term Storage for Hereditary Cancer Syndroms",
        "url" :
"/api/v2/eu_bbmri_eric_collections/bbmri-eric:ID:CZ_MMCI:collection:LTS:gDNA-HCS"
        },
        {
        "@id" :
"/api/v2/eu_bbmri_eric_collections/bbmri-eric:ID:CZ_MMCI:collection:LTS:gDNA-wholeblood
",
        "@type" : "DataRecord",
        "identifier" : "bbmri-eric:ID:CZ_MMCI:collection:LTS:gDNA-wholeblood",
        "name" : "Whole Blood (gDNA complement) in Long Term Storage Collection",
        "url" :
"/api/v2/eu_bbmri_eric_collections/bbmri-eric:ID:CZ_MMCI:collection:LTS:gDNA-wholeblood
"
        },
        {
        "@id" :
"/api/v2/eu_bbmri_eric_collections/bbmri-eric:ID:CZ_MMCI:collection:LTS:serum",
        "@type" : "DataRecord",
        "identifier" : "bbmri-eric:ID:CZ_MMCI:collection:LTS:serum",
        "name" : "Serum in Long Term Storage Collection",
        "url" :
"/api/v2/eu_bbmri_eric_collections/bbmri-eric:ID:CZ_MMCI:collection:LTS:serum"
        },
        {
        "@id" :
"/api/v2/eu_bbmri_eric_collections/bbmri-eric:ID:CZ_MMCI:collection:LTS:tissue-LN",
        "@type" : "DataRecord",
        "identifier" : "bbmri-eric:ID:CZ_MMCI:collection:LTS:tissue-LN",
        "name" : "Tissues in LN in Long Term Storage Collection",
```

```
        "url" :
"/api/v2/eu_bbmri_eric_collections/bbmri-eric:ID:CZ_MMCI:collection:LTS:tissue-LN"
        },
        {
        "@id" :
"/api/v2/eu_bbmri_eric_collections/bbmri-eric:ID:CZ_MMCI:collection:LTS:tissue-RNAlater",
        "@type" : "DataRecord",
        "identifier" : "bbmri-eric:ID:CZ_MMCI:collection:LTS:tissue-RNAlater",
        "name" : "Tissues in RNAlater in Long Term Storage Collection",
        "url" :
"/api/v2/eu_bbmri_eric_collections/bbmri-eric:ID:CZ_MMCI:collection:LTS:tissue-RNAlater"
        },
        {
        "@id" : "/api/v2/eu_bbmri_eric_collections/bbmri-eric:ID:CZ_MMCI:collection:STS",
        "@type" : "DataRecord",
        "identifier" : "bbmri-eric:ID:CZ_MMCI:collection:STS",
        "name" : "Short Term Storage Collection",
        "url" : "/api/v2/eu_bbmri_eric_collections/bbmri-eric:ID:CZ_MMCI:collection:STS"
        }
  ],
  "provider" : {
        "@id" :
"https://directory.bbmri-eric.eu/menu/main/dataexplorer/details/eu_bbmri_eric_biobanks/bbm
ri-eric:ID:CZ_MMCI",
        "@type" : "Organization",
        "identifier" : "bbmri-eric:ID:CZ_MMCI",
        "url" :
"https://directory.bbmri-eric.eu/menu/main/dataexplorer/details/eu_bbmri_eric_biobanks/bbm
ri-eric:ID:CZ_MMCI"
  }
}
```


Collection BioSchemas


```
{
  "@context" : "http://schema.org",
  "@id" : null,
  "@type" : [
        "DataRecord"
  ],
  "additionalProperty" : [
        {
        "name" : "diagnosis_available",
        "url" : "http://purl.obolibrary.org/obo/OGMS_0000073",
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"value" : "urn:miriam:icd:D37-D48",
"valueReference" : [
{
"@type" : "CategoryCode",
"codeValue" : "D37-D48",
"name" : "Neoplasms of uncertain or unknown behaviour",
"url" :
"https://directory.bbmri-eric.eu/api/v2/eu_bbmri_eric_disease_types/urn:miriam:icd:D37-D48"
}
]
},
{
"name" : "diagnosis_available",
"url" : "http://purl.obolibrary.org/obo/OGMS_0000073",
"value" : "urn:miriam:icd:D00-D09",
"valueReference" : [
{
"@type" : "CategoryCode",
"codeValue" : "D00-D09",
"name" : "In situ neoplasms",
"url" :
"https://directory.bbmri-eric.eu/api/v2/eu_bbmri_eric_disease_types/urn:miriam:icd:D00-D09"
}
]
},
{
"name" : "diagnosis_available",
"url" : "http://purl.obolibrary.org/obo/OGMS_0000073",
"value" : "urn:miriam:icd:D10-D36",
"valueReference" : [
{
"@type" : "CategoryCode",
"codeValue" : "D10-D36",
"name" : "Benign neoplasms",
"url" :
"https://directory.bbmri-eric.eu/api/v2/eu_bbmri_eric_disease_types/urn:miriam:icd:D10-D36"
}
]
},
{
"name" : "diagnosis_available",
"url" : "http://purl.obolibrary.org/obo/OGMS_0000073",
"value" : "urn:miriam:icd:C00-C97",
"valueReference" : [
{
"@type" : "CategoryCode",
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"codeValue" : "C00-C97",
"name" : "Malignant neoplasms",
"url" :
"https://directory.bbmri-eric.eu/api/v2/eu_bbmri_eric_disease_types/urn:miriam:icd:C00-C97"
}
]
},
{
"name" : "materials",
"value" : "DNA",
"valueReference" : [
{
"@type" : "CategoryCode",
"codeValue" : "DNA",
"name" : "DNA",
"url" : "https://directory.bbmri-eric.eu/api/v2/eu_bbmri_eric_material_types/DNA"
}
]
},
{
"name" : "materials",
"value" : "Other",
"valueReference" : [
{
"@type" : "CategoryCode",
"codeValue" : "OTHER",
"name" : "Other",
"url" : "https://directory.bbmri-eric.eu/api/v2/eu_bbmri_eric_material_types/OTHER"
}
]
},
{
"name" : "materials",
"value" : "Serum",
"valueReference" : [
{
"@type" : "CategoryCode",
"codeValue" : "SERUM",
"name" : "Serum",
"url" : "https://directory.bbmri-eric.eu/api/v2/eu_bbmri_eric_material_types/SERUM"
},
{
"@type" : "CategoryCode",
"name" : "blood serum specimen",
"url" : "http://purl.obolibrary.org/obo/OBI_0100017"
}
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]
},
{
"name" : "materials",
"value" : "Whole Blood",
"valueReference" : [
{
"@type" : "CategoryCode",
"codeValue" : "WHOLE_BLOOD",
"name" : "Whole Blood",
"url" :
"https://directory.bbmri-eric.eu/api/v2/eu_bbmri_eric_material_types/WHOLE_BLOOD"
},
{
"@type" : "CategoryCode",
"name" : "blood specimen",
"url" : "http://purl.obolibrary.org/obo/OBI_0000655"
}
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},
{
"name" : "materials",
"value" : "Tissue (frozen)",
"valueReference" : [
{
"@type" : "CategoryCode",
"codeValue" : "TISSUE_FROZEN",
"name" : "Tissue (frozen)",
"url" :
"https://directory.bbmri-eric.eu/api/v2/eu_bbmri_eric_material_types/TISSUE_FROZEN"
},
{
"@type" : "CategoryCode",
"name" : "frozen specimen",
"url" : "http://purl.obolibrary.org/obo/OBI_0000922"
}
]
},
{
"name" : "data_categories",
"value" : "BIOLOGICAL_SAMPLES"
},
{
"name" : "data_categories",
"value" : "IMAGING_DATA"
},
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        {
        "name" : "data_categories",
        "value" : "MEDICAL_RECORDS",
        "valueReference" : [
        {
        "@type" : "CategoryCode",
        "name" : "sample medical record",
        "url" : "http://purl.obolibrary.org/obo/OMIABIS_0001027"
        }
        ]
        },
        {
        "name" : "data_categories",
        "value" : "NATIONAL_REGISTRIES"
        },
        {
        "name" : "data_categories",
        "value" : "PHYSIOLOGICAL_BIOCHEMICAL_MEASUREMENTS"
        },
        {
        "name" : "data_categories",
        "value" : "SURVEY_DATA",
        "valueReference" : [
        {
        "@type" : "CategoryCode",
        "name" : "survey data",
        "url" : "http://purl.obolibrary.org/obo/OMIABIS_0000060"
        }
        ]
        }
  ],
  "provider" : {
        "@id" :
"https://directory.bbmri-eric.eu/menu/main/dataexplorer/details/eu_bbmri_eric_biobanks/bbm
ri-eric:ID:CZ_MMCI",
        "@type" : "Organization",
        "identifier" : "bbmri-eric:ID:CZ_MMCI",
        "url" :
"https://directory.bbmri-eric.eu/menu/main/dataexplorer/details/eu_bbmri_eric_biobanks/bbm
ri-eric:ID:CZ_MMCI"
  }
}
```