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D5.5 Second Data Resource Browser

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Carlos A Velasco (Fraunhofer)	08-10-2018	Accepted with minor comments

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1 Executive Summary

The PICASO Data Resource Browser is a web-based tool which allows clinicians to browse information stored in the PICASO. The Data Resource Browser is part of the Clinician Dashboard and is linked to the information gathered in the Patient Data Viewer. This tool follows the paradigm of a computer's file manager but restricted to read only features. Using this, the clinician can have an overall view of the data resources that are available in PICASO shared memory and is available to her/him. The detailed view of data and their editing of the available resources is out of the scope of this tool. The browser offers a dynamic and interactive mind map, populated with the existing resources and focusing on the effective information model, the data's physical location and last modified date. The in-depth view of data by clinician is supported with other PICASO clinical tools. The dynamic map of Date Resource Browser is generated based on the response from Patient Data Orchestrator. This PICASO component orchestrates all available information resources about selected patient from relevant clinician Operational Data Storages. The relevancy of particular Operational Data Storage is known by consulting Meta Data Registry.

2 Introduction

2.1 Purpose, context and scope of this deliverable

This deliverable presents the outcome so far of Task 5.3 Data Resource Browser (DRB) under WP5 Privacy Enhanced Integrated Data Management. This is the second iteration of the DRB. The previous iteration was delivered / documented under D5.3 First Data Resource Browser (M10). The final version of DRB tool is delivered as part of the PICASO integrated care platform. Such integration required full implementation of DRB features and thus (by such DRB implementation) project milestone MS8 is considered as achieved.

2.2 Intellectual Property (IP)

The different components of the Data Resource Browser are subject to open source and commercial licences, which are subject to the licences reflected in the IP repository being created for the project.

2.3 Content and structure of this deliverable

Section 3 presents the requirements for the DRB with screenshot samples from the DRB application (where applicable) and explanation how the requirements were fulfilled. Section 4 presents the User Interface. Section 5 provides information about the technical architecture while Section 6 describes implementation details, employed technologies and discuss further use of the DRB tool.

3 Requirements

This section presents the user requirements directly or indirectly related to the DRB tool. Each requirement is followed by comments giving explanation how the requirement is fulfilled and screenshot from DRB application providing demonstration (where applicable).

3.1 PIC-72 Medical professionals are provided a graphical presentation of self-recordings from questionnaires FFbH/HAQ and RADAI as well as patient’s pain ratings (only UDUS).

Rational	It must be possible for medical professionals to easily browse patient’s personal ratings on FFbH/HAQ and RADAI questionnaires and his/her pain ratings. Visualization of results in graphs supports the need of medical professionals to get a quick overview of a patient's current health status.
Fit Criterion	Graphical presentation of results from a patient’s self-recordings on FFbH/HAQ, RADAI and pain status is provided and can be filtered by time slots (daily, weekly, monthly). Measurements below or above defined thresholds are indicated. Medical professionals can also have an integrated view on pain ratings and different types of measurements taken by the home monitoring platform (e.g., pain ratings combined with results from blood pressure and heart rate variability measurements).
Technical features	<ul style="list-style-type: none"> Show Questionnaires including date and location
Comments	FFbH/HAQ, RADAI as well as Well-being and Morisky can be seen under Home measurements > Questionnaires and under RA-Questionnaires (UDUS cases) and PD Questionnaire (UTV cases) nodes/data categories. Such presentation follows the definition from PICASO deliverable D2.4. See the also screenshot in Figure 1.

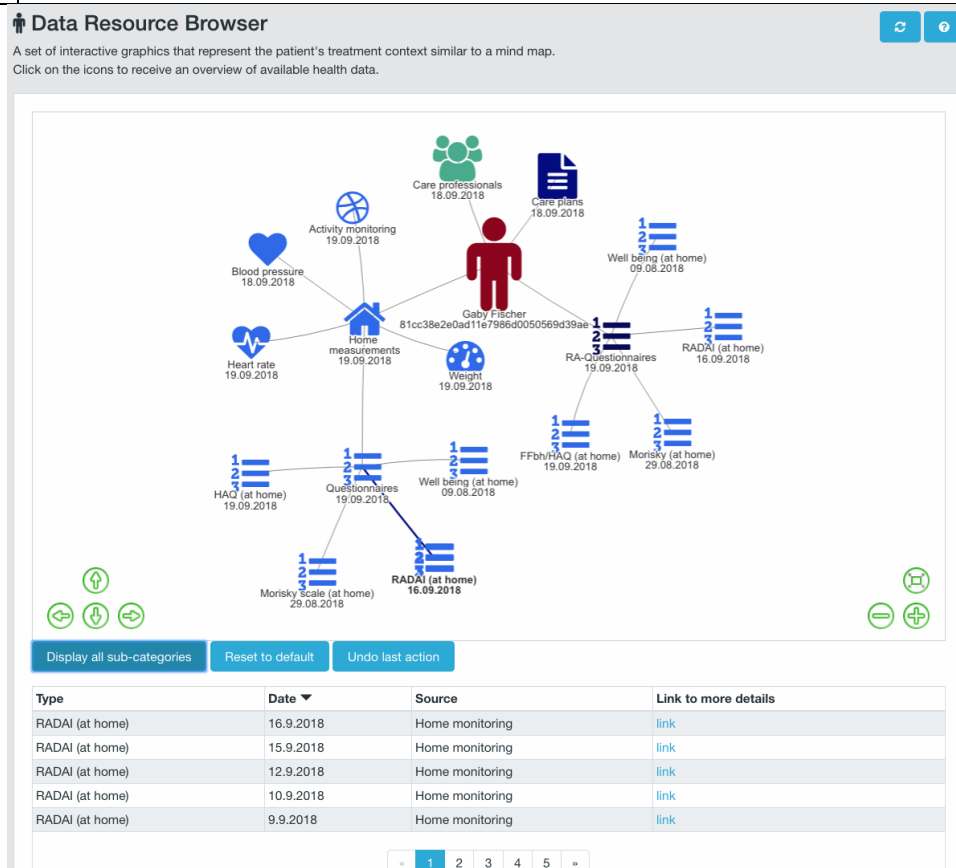


Figure 1: Patient’s self-monitoring displayed under two categories

3.2 PIC-74 Patient information should be presented to requesting medical professional according to relevance

Rational	Patient records consist of many different pieces of information (e.g. results of physical exams, blood tests, scans, surgeries) not equally relevant for medical professionals. To support medical professionals in achieving their treatment goals, it is important to filter patient information according to relevance for the treating medical professional. Because information needs vary among medical professionals, this will need to be configurable by medical professionals.
Fit Criterion	Patient information is presented to medical professionals according to preconfigured relevance
Technical features	<ul style="list-style-type: none"> • Group resources based on the professional carer's role • Make configurable the list of relevant resources per professional carer's role
Comments	Medical professionals have user roles assigned (e.g. rheumatologist, cardiologist etc.). These roles are maintained in the PICASO Policy Manager. They are used by Patient Data Orchestrator to filter data response based on the authorisation access matrix of specific role and as a result data of that the irrelevant categories (for certain clinician) are filtered. The filtered data response itself enables unimportant patient information to be not presented by DRB mind map.

3.3 PIC-80 Data must not be kept for longer than necessary.

Rational	In accordance with data protection principles, data can and will be deleted from PICASO system if a patient withdraws from the trial or when data is no longer necessary to keep, e.g. end of project. This applies also for session caching.
Fit Criterion	Patient data in PICASO can be deleted 100%. Same for cache.
Technical features	<ul style="list-style-type: none"> • Keep DRB data as long as the DRB application is used.
Comments	Once user log off the Clinician Dashboard cached data serving for DRB application are cleared.

3.4 PIC-104 Patient needs to be able to decide with whom they want to share which information from their patient record.

Rational	Patients needs to be able to decide with whom they want to share which information from their patient record.
Fit Criterion	Only information that the patient has allowed to share with a certain medical professional or an informal carer, can be accessed by him or her. Patients can decide upon this at any time.
Technical features	<ul style="list-style-type: none"> • Show only data resources that the patient has shared
Comments	Directly N/A to DRB. Note, authorisation access rights over his/her information is defined over Patient Dashboard and maintained in the PICASO Policy Manager. They are used by Patient Data Orchestrator to filter data response based on this authorisation. The filtered data response itself enables patient information to be presented by DRB mind map in alignment with the restriction defined by Patient.

3.5 PIC-109 A medical professional needs to know about all professional roles involved in a patient's treatment.

Rational	In order to get a quick overview on a patient's treatment situation, medical professionals should be visualised what kind of professional roles are involved in the treatment of this patient.
Fit Criterion	For every patient all involved professional roles are visualised.
Technical features	<ul style="list-style-type: none"> Visualize of involved professional roles
Comments	The roles of medical professionals involved in the patient's treatment are visualised under dedicated node. When clicked the node is expanded and shows all such roles. When clicking on the specific node of medical role new specific view is displayed giving only information related to this medical role. In this specific view, the medical role is in the centre and all data categories are around it (clinician centric view). See the also screenshot in Figure 2 and Figure 3.

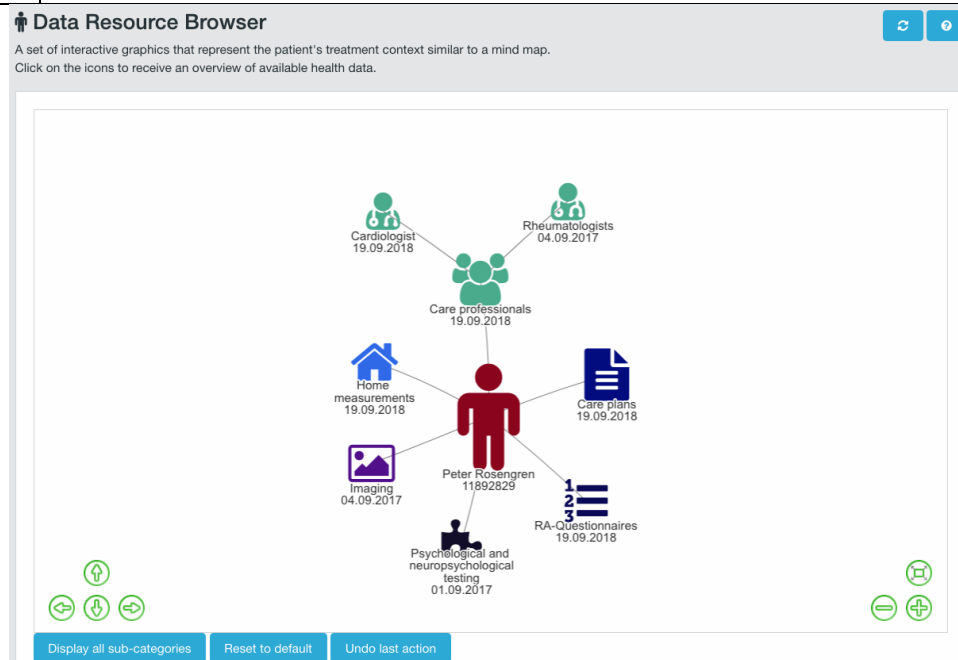


Figure 2: Medical roles involved in demo patient's treatment

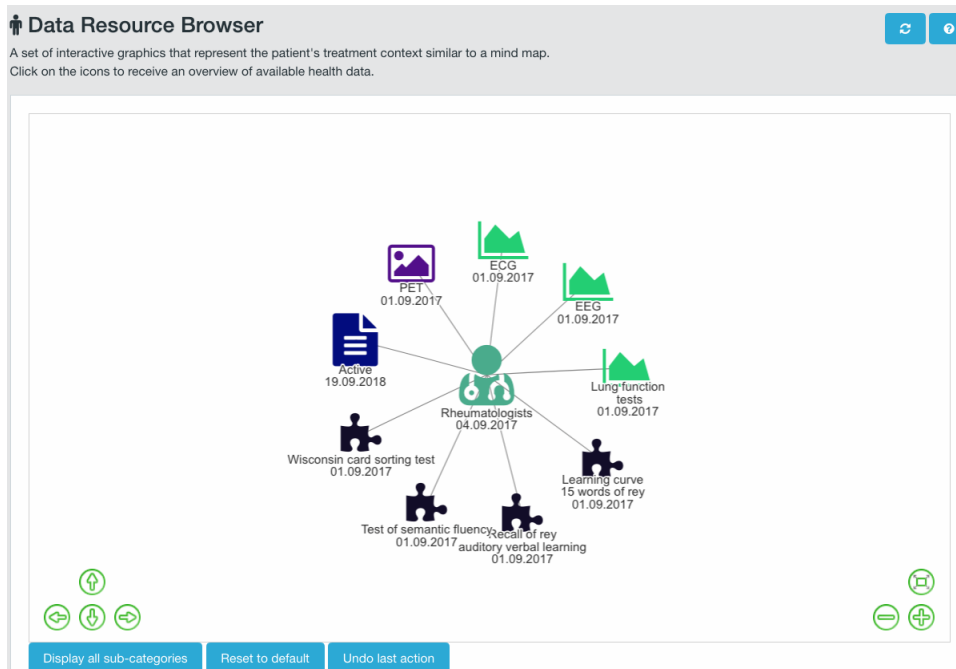


Figure 3: Data categories of data produced by medical professionals with Rheumatologist role in clinician centric view

3.6 PIC-110 A medical professional needs to know about types of home monitoring measurements and recordings

Rational	A medical professional should be able to get a quick overview on what type of sensors are actively used in a patient's home monitoring setting and what patient recordings are available (e.g., pain recordings) in order to know which results he/she can expect. For trial 2 types of sensors that have been used previously, but are not active at the moment, shall also be visualisable
Fit Criterion	For every patient all types of home monitoring measurements and recordings are visualised to medical professionals according to their access rights.
Technical features	<ul style="list-style-type: none"> Visualize all types of home monitoring and measurements according to the access rights
Comments	The visualisation of the information is done under Home measurements node. See the also screenshot in Figure 2.

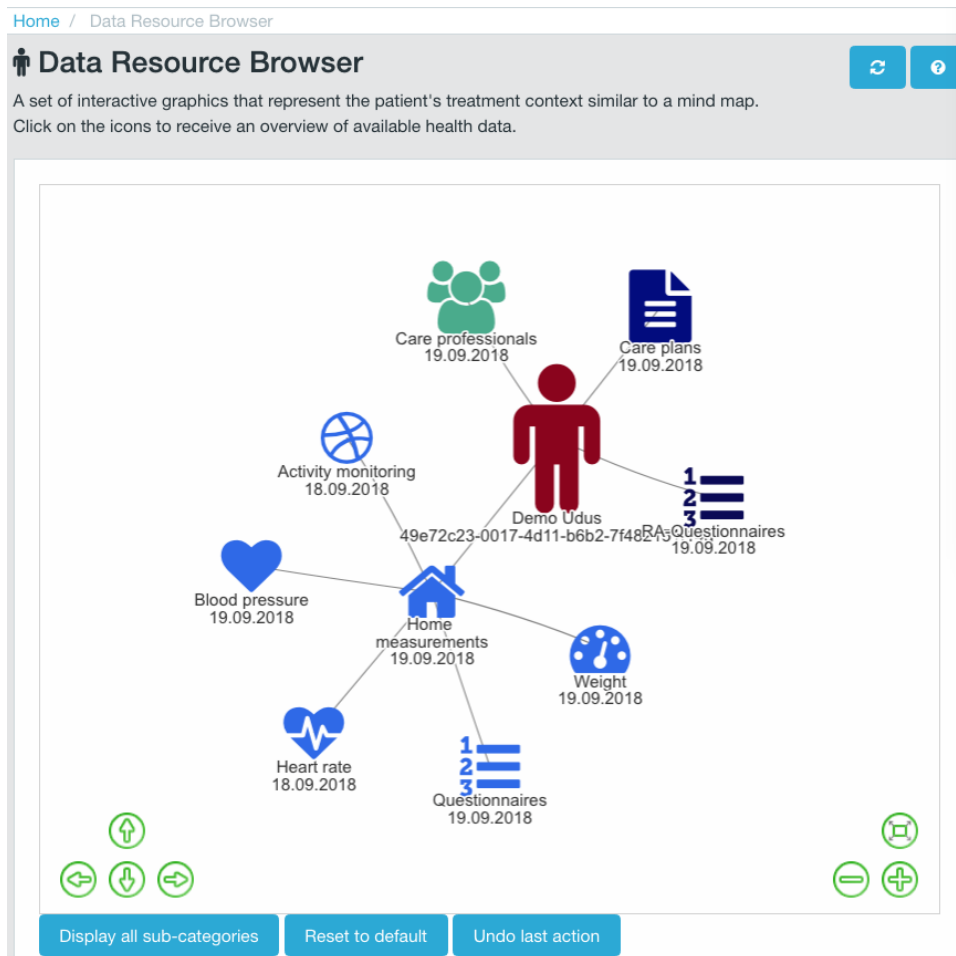


Figure 4: Overview on what type of sensors are actively used in a patient’s home monitoring setting and what patient recordings are available. Node name corresponds to the recording available. Date under the node name indicates newest entry available.

3.7 PIC-111 A medical professional needs to be able to search for different types of available information

Rational	Medical professionals should be able to search for metadata information available in PICASO about a certain type of information, e.g., professional roles involved in a patient’s treatment or types of conducted lab exams.
Fit Criterion	For every search by a type of available data the correct metadata needs to be visualised.
Technical features	<ul style="list-style-type: none"> Show nodes representing categories of available data
Comments	This requirement is covered by interactive expanding of categories (represented as nodes) into sub-categories when user click on the node.

3.8 PIC-113 Patients are provided constantly available material with instructions on how to use sensors and the applications on the Patient Dashboard. UDUS/UTV: Provide instructions on how to use sensors (handbook, videos etc.).

Rational	For the trials patients need to have information constantly available, e.g., in form of a 'handbook', video clip or the like, on how to use properly sensors of the home monitoring platform and applications of the Patient Dashboard, e.g., for self-recordings.
Fit Criterion	Patients are provided constantly available material such as a handbook with instructions on how to use sensors for home monitoring and applications on the Patient Dashboard properly.
Technical features	<ul style="list-style-type: none"> Show supporting material
Comments	N/A for the DRB, as this tool is part of Clinician Dashboard. The Clinician Dashboard was designed and is used by medical professionals only. The supporting materials are provided over Patient Dashboard.

3.9 PIC-114 Under home monitoring provide a list of measurements and recordings types from a predefined list

Rational	based on PIC-110
Fit Criterion	based on PIC-110
Technical features	<ul style="list-style-type: none"> Show measurements and recordings
Comments	List of measurements (or history of events) is displayed under DRB mind map after the most specific data categories of the mind map are selected. See the also screenshot in Figure 5.

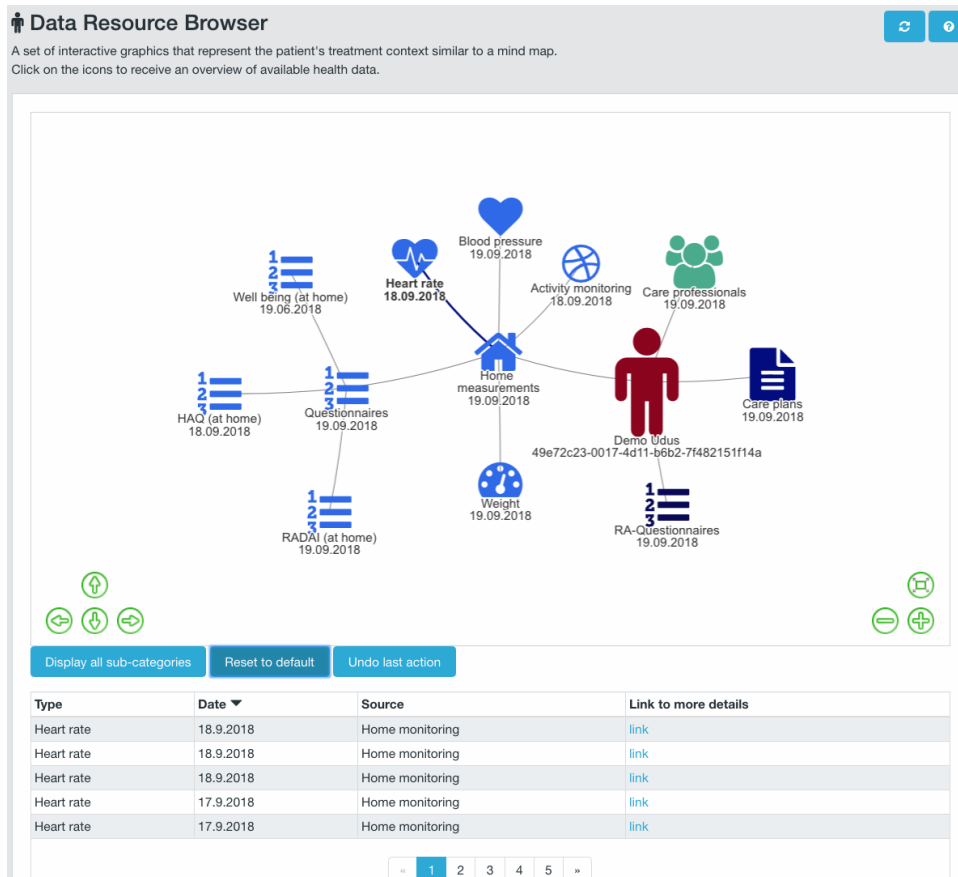


Figure 5: List of measurements under the mind map indicating type of measurement.

4 Design

4.1 Information model and GUI of DRB tool

The information model behind the DRB mind map structure is specified in D2.4. The basis of such model comes from PICASO CIM (i.e. PICASO Common Information Model defined in D5.1). Such specification provides hierarchy of data categories with subcategories. Such categorisation gives information perspective to the data available about specific patient. The final categorisation is result of iterative E2E sessions in which the final design of the DRB tool was tuned in cooperation between developers, usability consultants and clinicians. The sessions started with mock-up like DRB tool. First mock-up was based on the prototype presented in previous version of the deliverable (D5.3). Each iteration took about two weeks. There was new prototype of DRB tool ready for each of such E2E session. Such prototype reflects all new requirements coming from the previous session. Such agile development process lasts about six months. At the end, the DRB tool appearance and functionalities were close to its current state. As this development process was done based on simulated data, another step forward was done when the DRB tool was integrated with real source of PICASO data.

First, clinicians initiate the browser by searching for a specific patient. Note, such patient is then examined by more tools of Clinician Dashboard (not only DRB) and thus, selection of patient is functionality of Clinician Dashboard. The DRB tool displays icon representing patient in the very centre. Label of the icon is placed below. It contains name and ID of the patient. There are main data categories displayed in a circular way around the patient. Each category is represented by specific combination of icon (fontawesome !!) and colour chosen during E2E session. Specific label is displayed below each icon. The label contains name of the data category and date. The date corresponds to the latest date of available data belonging to the category.

4.2 Navigation

Different care professionals can follow different path ways by clicking on category of his/her interest. Such clicking expands selected category and relevant subcategories are displayed. Once no more subcategories exist, list of relevant data entries is displayed below the mind map. The list contains type, date, source and link to other PICASO clinician tool for detailed examination of the data. There is also one separated view on the information available. It is called clinician centric view. This view is presented when user click on concrete clinician role in the main mind map. The clinician centric view displays those data categories based on data created by clinicians with the 'clicked' role (e.g. rheumatologists see Figure 3 above).

The above described interactive navigation is considered as a basis for clinicians to obtain good overview of what data are available for a patient. Figure 6 presents appearance of initialised mind map.

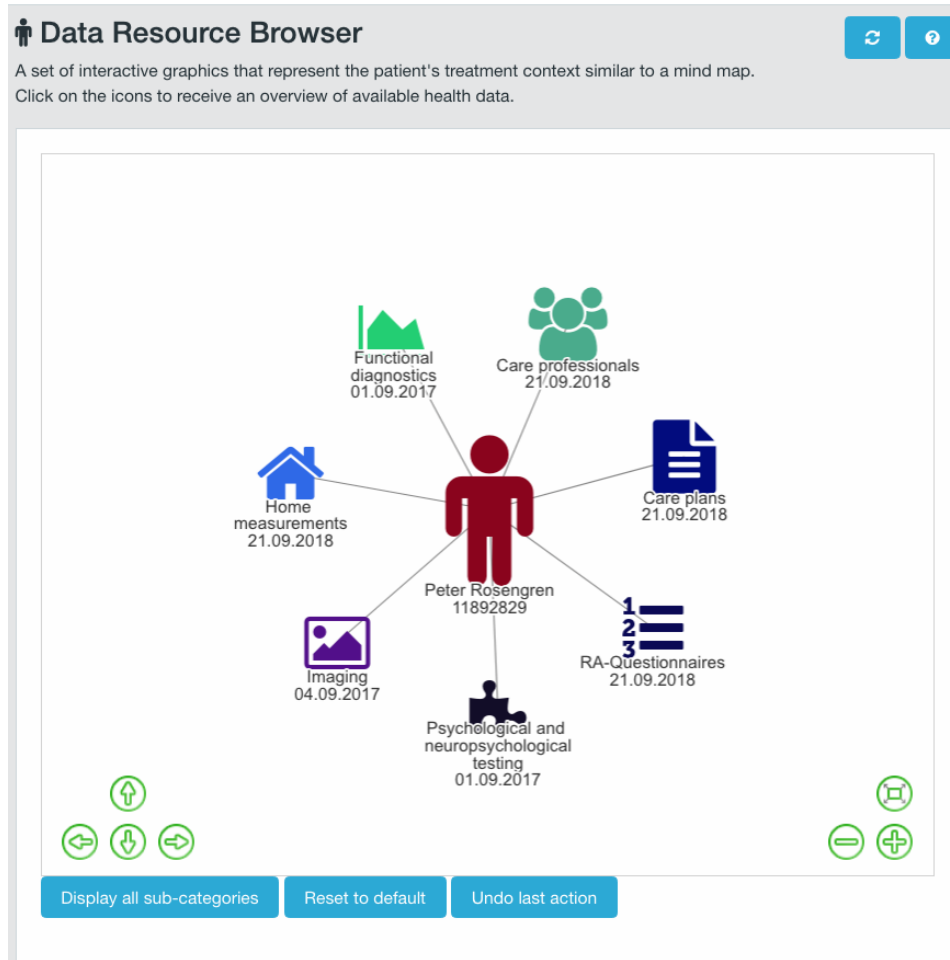


Figure 6: initial mind map

Figure 7 gives notion of expanding functionality.

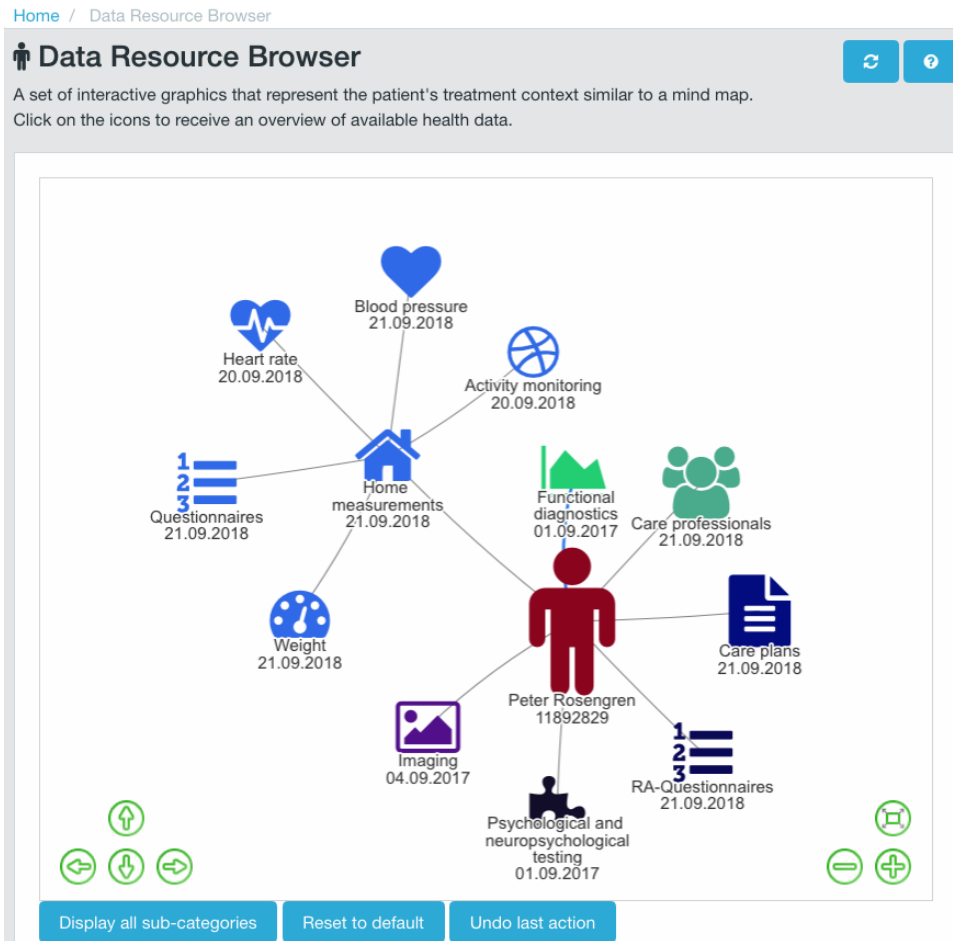


Figure 7: Expanding of node functionality demonstration

Figure 8 presents list of data under the mind map.

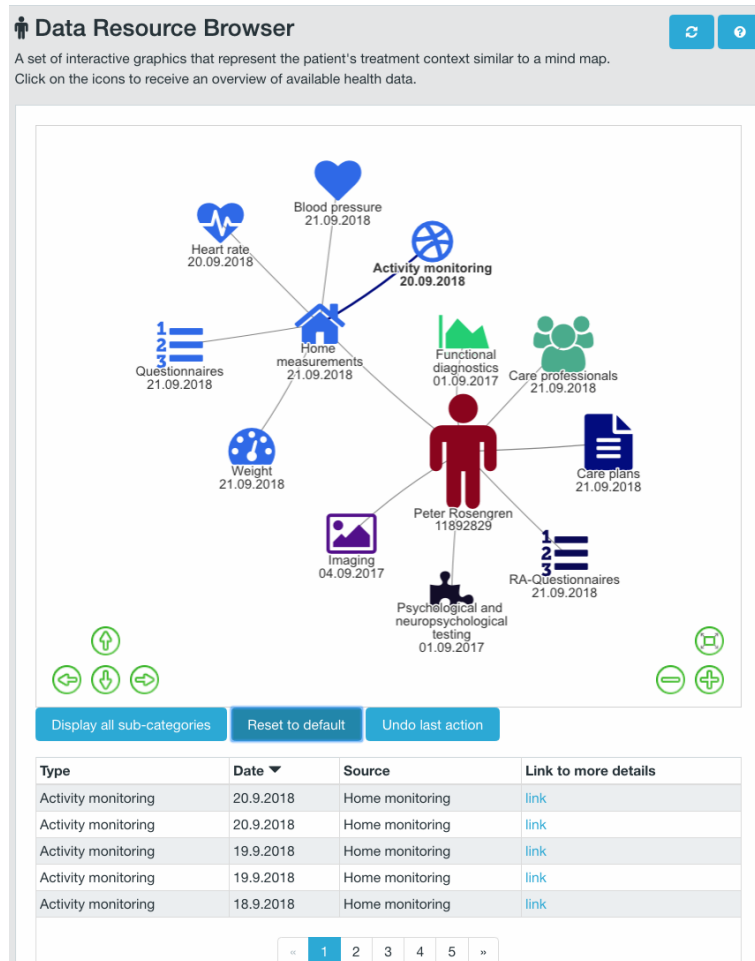


Figure 8: List of available data from Activity monitoring below the mind map

Figure 9 displays fully expanded mind map (based on simulated data).

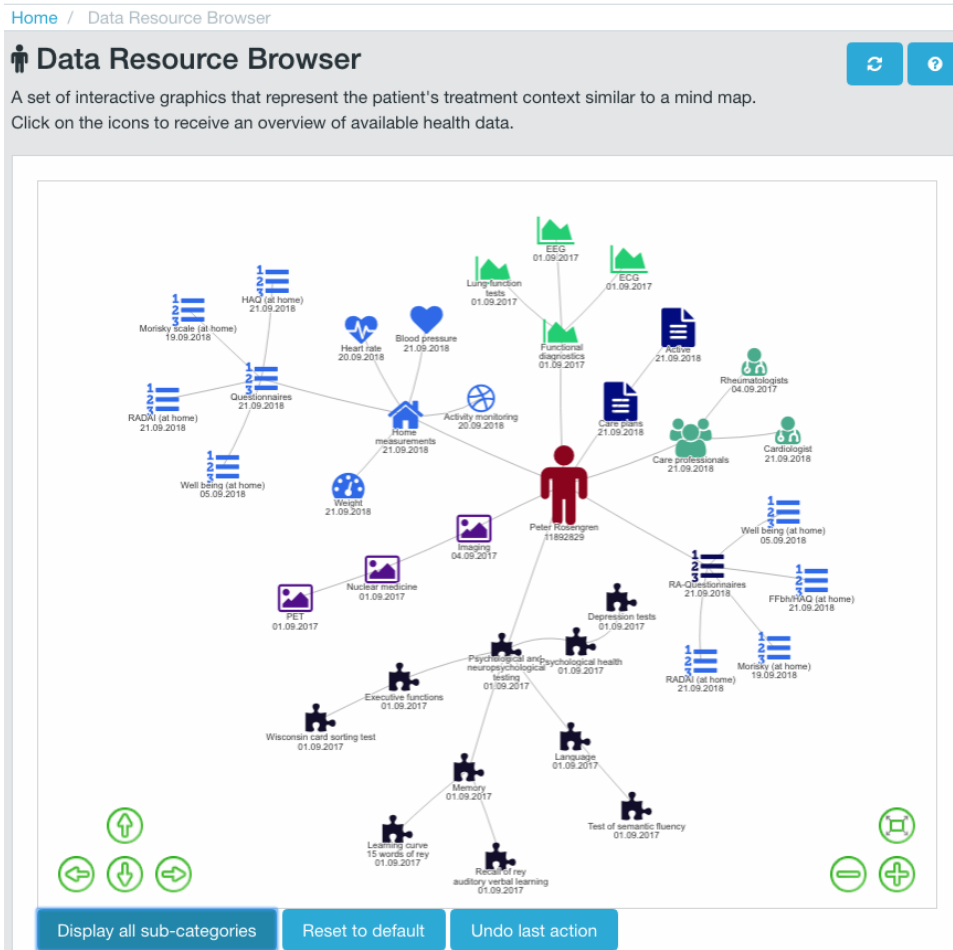


Figure 9: Fully expanded mind map (based on simulated data)

Note, overall, there are more than 110 nodes predefined for the PICASO DRB Mind Map.

5 Architecture

The Data Browser is a read-only tool. It does not write any data within PICASO, other than to the Activity Log for logging access to data.

Figure 10 provides an updated architecture zoom comparing to the D5.3. The DRB depends closely on the following components:

- the Patient Data Orchestrator which is responsible for orchestration of all responses from ODS systems and prepares these data responses in the format used by DRB for visualisation
- the Activity Log which is responsible of inserting log entries on every data access
- the Clinician Dashboard which serves for patient selection and plays important role in proper secure calls of PICASO data services invoked by DRB
- Patient Data Viewer handles the detailed view of data. Specific link is constructed in DRB. This link contains information about data type and date which are based on the selected DRB data category. The link is then/when clicked interpreted by Patient Data Viewer.
- Care Plan Manager is called over link addressing this tool over Clinician Dashboard in case of care plan need to be examined by the clinician. Note, the general link to the Care Plan Manager tool is used. Thus, no specific link based on the selected specific DRB data category is created by DRB. That is why no direct dependency is depicted on the diagram presenting dependencies on Figure below.

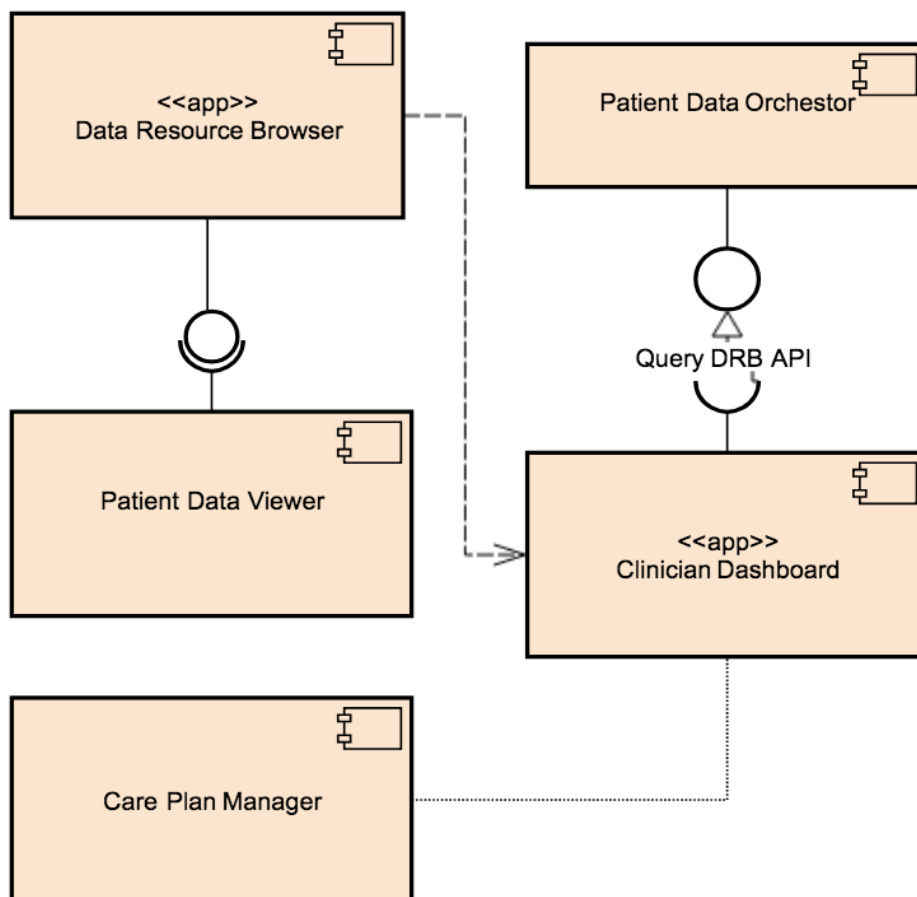


Figure 10: Data Resource Browser Architecture – Dependencies

6 Implementation

The implementation of DRB is based on Angular technology. Thus, TypeScript programming language is used to define logic of DRB functionalities. The implementation defines data model reflecting data categorisation defined in D2.4 and JIRA requirements described in section 3.

The DRB application itself consists of about 4000 lines of code in TypeScript, JSON HTML and CSS. The following statistics from the common PICASO development repository describes the development process in numbers:

insertions:	45463
deletions:	29417
files:	75
commits:	65
lines changed:	74880
first commit:	Fri Mar 17 15:10:47 2017 +0100
last commit:	Tue Sep 18 15:51:38 2018 +0200

6.1 Data response matching the model of categorisation

The DRB is based on the data stored in the Clinical ODSes. To access them, the specific data service (read only) on the Patient Data Orchestrator is called by DRB. The response from this service orchestrates particular responses from all relevant ODSes. Data from such response are mapped against the model of data categorisation.

```
{
  "subGraphId": "homeMeasurements",
  "parentGraph": "core",
  "isDisplayed": false,
  "title": "",
  "id": "heartrate",
  "label": "Heart rate",
  "group": "HomeHeart"
},
{
  "subGraphId": "homeMeasurements",
  "parentGraph": "core",
  "isDisplayed": false,
  "title": "",
  "id": "activitymonitor",
  "label": "Activity monitoring",
  "group": "HomeActivity"
},
}
```

Figure 11: Simple example from model of data categorisation (There are more than 110 items in this model.)

This model is defined for DRB specifically. As can be seen in Figure 11, it uses JSON syntax. Such model is interpreted by the DRB code. It uses same ids for data as used in ODS. Each id has its label. The labels follow the definition of categorisation. They are displayed to clinicians and they might slightly differ from texts used in other PICASO components (esp. those used by patients). Each ID represents one node in the DRB Mind Map. The model associates parent graph and sub-graph with the id to define its place in the structure of Mind map. Group is associated to be able to choose the right icon for the node. The technology employed defines

such groups. Each group has many possible parameters. The most important for our case is icon (other are e.g. font, width, border width). The icon is further specified by type of icons (“FontAwesome”) code of the icon, size of icon and colour. Currently the definition of Group is coded in DRB application directly as there was no much demand for changes of icons and label characteristics (also see discussion about new mind map definition below).

Thus, the data category (id in Mind Map definition) matching the data response (id from ODS) cause node with its name, label, specific FontAwesome icon, colour and edge from the node to the parent node to be added into vis.js Network object (Figure 12). The vis.js Network updates the visualisation based on its updated data object automatically. The functionality of interactive expanding and collapsing of nodes is performed by revealing and hiding of the related nodes.

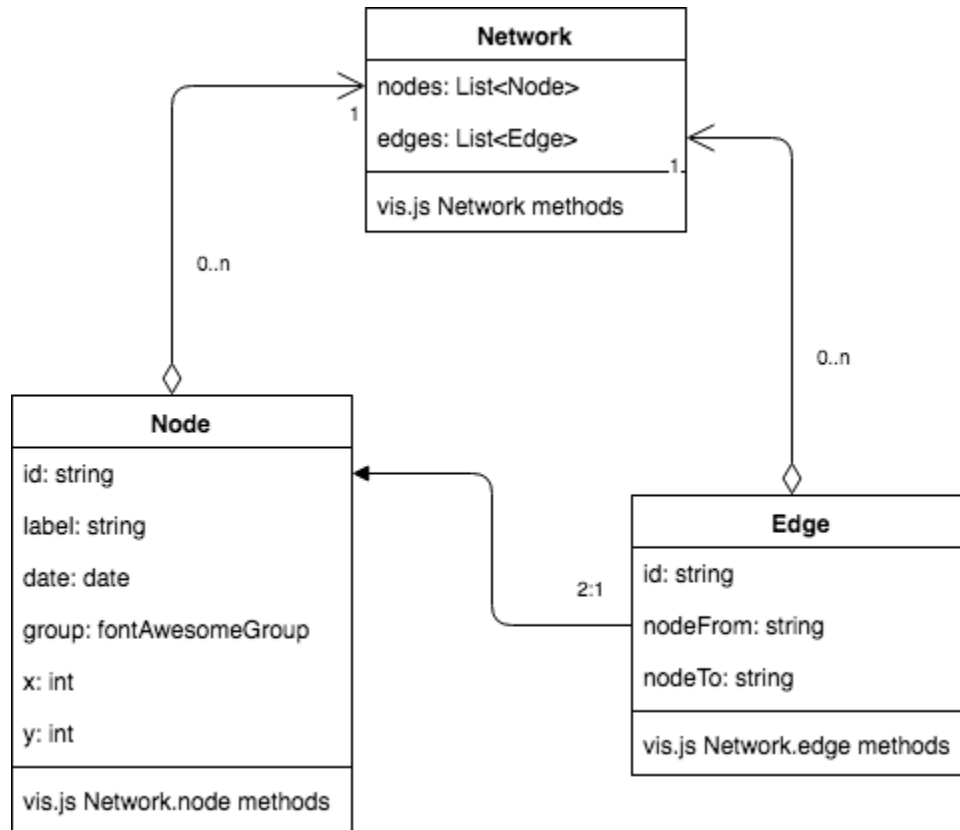






Figure 12: Model of Mind Map derived from the model of vis.js Network technology

Note, the positions of nodes of Mind Map are dynamically calculated by the DRB application (initial estimated optimal position) together with the ‘physics’ defined by the vis.js Network technology (optimal position based on the repulsion ‘forces’ among).

The date under the node is part of node’s label. Such date comes from the data response.

The groups in the model of data categorisation are associated with Font Awesome icons and colour. Each group is defined by one icon (Font Awesome id) and one colour (colour code). Samples of the mapping between Font Awesome icons and main data categories follow:

-  • f183 • `<i class="fas fa-male"></i>` -> Patient;
-  • f0c0 • `<i class="fas fa-users"></i>` -> Care Professionals;
-  • f15c • `<i class="fas fa-file-alt"></i>` -> Care Plans;
-  • f015 • `<i class="fas fa-home"></i>` -> Home Measurements;
-  • f0cb • `<i class="fas fa-list-ol"></i>` -> RA-Questionnaires, PD-Questionnaires;

-  • f12e • *<i class="fas fa-puzzle-piece"></i>* -> Psychological and Neuropsychological Testing;
-  • f03e • *<i class="fas fa-image"></i>* -> Imaging;
-  • f1fe • *<i class="fas fa-chart-area"></i>* -> Functional diagnostics;
-  • f0c3 • *<i class="fas fa-flask"></i>* -> Lab Tests;
-  • f12a • *<i class="fas fa-exclamation"></i>* -> Surgeries;
-  • f1de • *<i class="fas fa-sliders-h"></i>* -> Patient Reported Outcomes.

6.2 APIs

The Data Resource Browser is a front end tool that needs to read data from the Patient Data Orchestrator component. It follows the APIs for such a communication is specified.

6.2.1 Data Orchestration API

Description	Path	method	parameters	response
Get All data for DRB per patient for clinician	https://picaso.eu/orch/patient/UPID/forDRB	GET	ID of patient ID of clinician	ON format specific DRB

Samples of data response follows:

```

}
  "results": [
  {
    "meta-data": {"data-type": "patient-for-drb"...},
    "data": {
      "resultForDRB": {
        "patient": {"name": "TEST DATA Henrike Weber"...},
        "homeMeasurements": [...],
        "carePlan": [...],
        "funcDiagnostic": [...],
        "imaging": [...],
        "questionnaire": [...],
        "labTest": [...],
        "psychoTest": [...],
        "careProfessionals": [...],
        "patReported": []
      }
    }
  }
]
}

```

Figure 13: Sample of data response with JSON nodes collapsed

```
"results": [
  {
    "meta-data": {"data-type": "patient-for-drb"...},
    "data": {
      "resultForDRB": {
        "patient": {
          "name": "TEST DATA Henrike Weber",
          "age": 50,
          "gender": "F"
        },
        "homeMeasurements": [
          {
            "TypeId": "bloodpressure",
            "ListOfEntries": [
              {
                "Timestamp": "2017-08-01T07:58:53.000Z",
                "TypeId": "diastolic",
                "LOINC": "8480-4",
                "Value": "79",
                "UnitCode": "mmHg"
              },
              {
                "Timestamp": "2017-08-01T07:58:53.000Z",
                "TypeId": "systolic",
                "LOINC": "8480-6",
                "Value": "105",
                "UnitCode": "mmHg"
              }
            ]
          }
        ]
      }
    }
  }
]
```

Figure 14: Sample of data response with expanded JSON nodes

6.3 Protocols

- HTTPS/REST

6.4 Technological landscape

- Web technologies
- Vis.js visualization library¹
- AngularJS version 1²
- NodeJS³
- Font Awesome⁴

6.5 Definition of new mind map - discussion

In case a new mind map has to be defined for DRB, the definition of the new Mind Map model (see above) is needed. This includes also definition of new groups specifying icons with their details. Then, the source of data providing same ids as used in the Mind Map definition with information necessary (lists of entries associated

¹ <http://visjs.org/>

² <https://angularjs.org/>

³ <https://nodejs.org/>

⁴ <https://fontawesome.com/free>

with ID including dates of entries – see Figure 13 and Figure 14). If the structure of these data (hierarchy) is the same as the structure of the Mind Map definition, then, possibly, no programming or just a little bit of programming is needed. Otherwise, e.g. in case the Mind Map is redefined many times, the quicker way might be to redefine Mind Map and do some extra programming on the DRB side.

Theoretically, the Mind Map should represent the structure of the data from data source only. Then the definition of the position of the node in the mind map is not needed and the model can be reduced to the definition of icons. However in the iterative nature of the research project (such as PICASO) this would cost extra effort and delay the solution significantly. For possible commercial application, it would be worth to tune DRB tool based on this idea. Such updated DRB would fully covers the structure of data source (data response) and provides GUI for Icon specification and other visual characteristics of Mind Map only. The tool would not be limited by the health care domain and could be considered as a generic interactive information visualisation tool.

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