

# Big Data and B2B Platforms: the next big opportunity for Europe



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## 2<sup>nd</sup> Workshop Infrastructure of health databases in T2D

Big Data and B2B platforms: the  
next big opportunity for Europe

EASME/COSME/2018/004



Brussels  
17 Sep, 2019

## › Infrastructure of health databases in T2D

## Initial plan for FAIRPOINT

Intervention study 1  
Intervention study 2  
Intervention study 3



Cohort 1  
Cohort 2  
Cohort 3



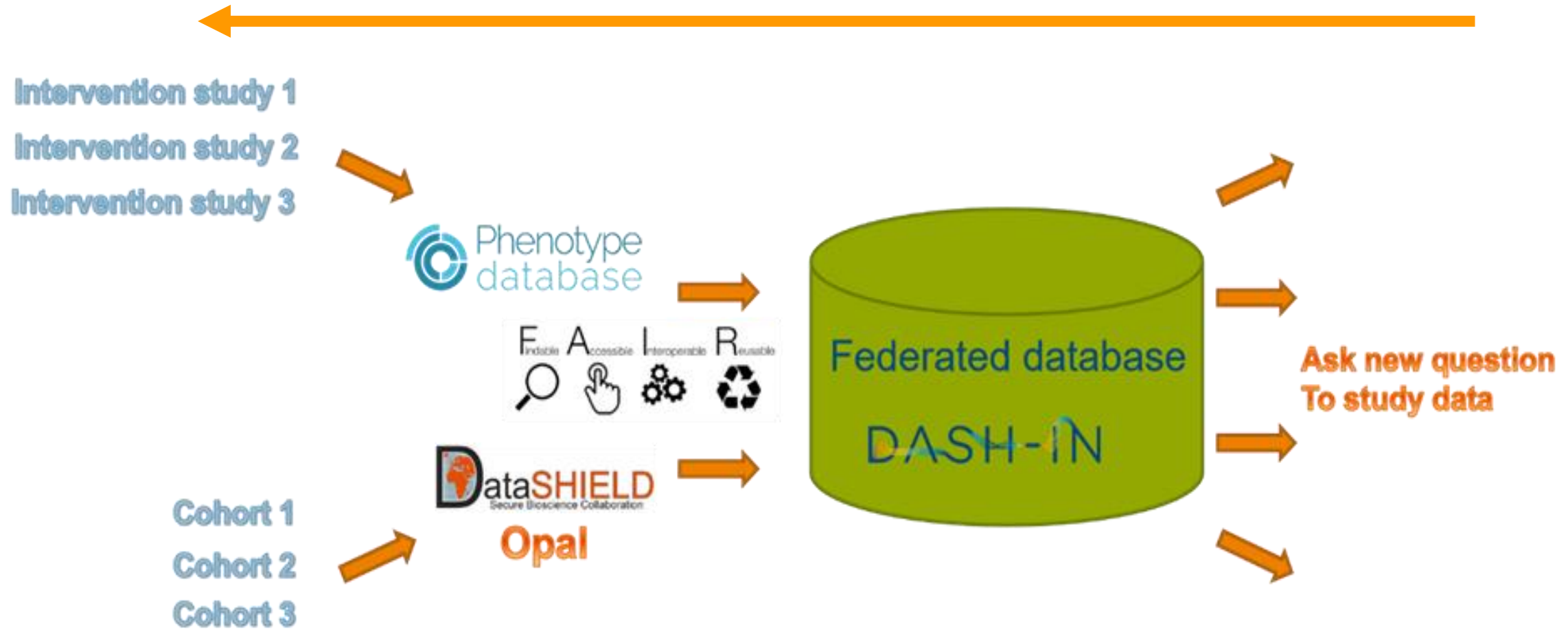
Ask new question  
To study data

## › Lessons first workshop

- Federated solutions preferred over central IT-infrastructure → continuation of implementation the DataShield
- Apply FAIR principles for better health data management.
- “If you don’t have to share, do not share”, Only share what is valuable for the specific request.
- The pilot should be fully compliant to GDPR and thereby privacy will be preserved
- Dynamic consent for a more effective handling of sharing health data; for the real-world data
- Important to come up with a minimum set of semantic standards (e.g. controlled vocabularies, data dictionaries)
- Key is to have clear metadata so to be able to judge the quality of the underlying data
- There should be openness on what is feasible and what not, we will/cannot resolve all but take it step by step.

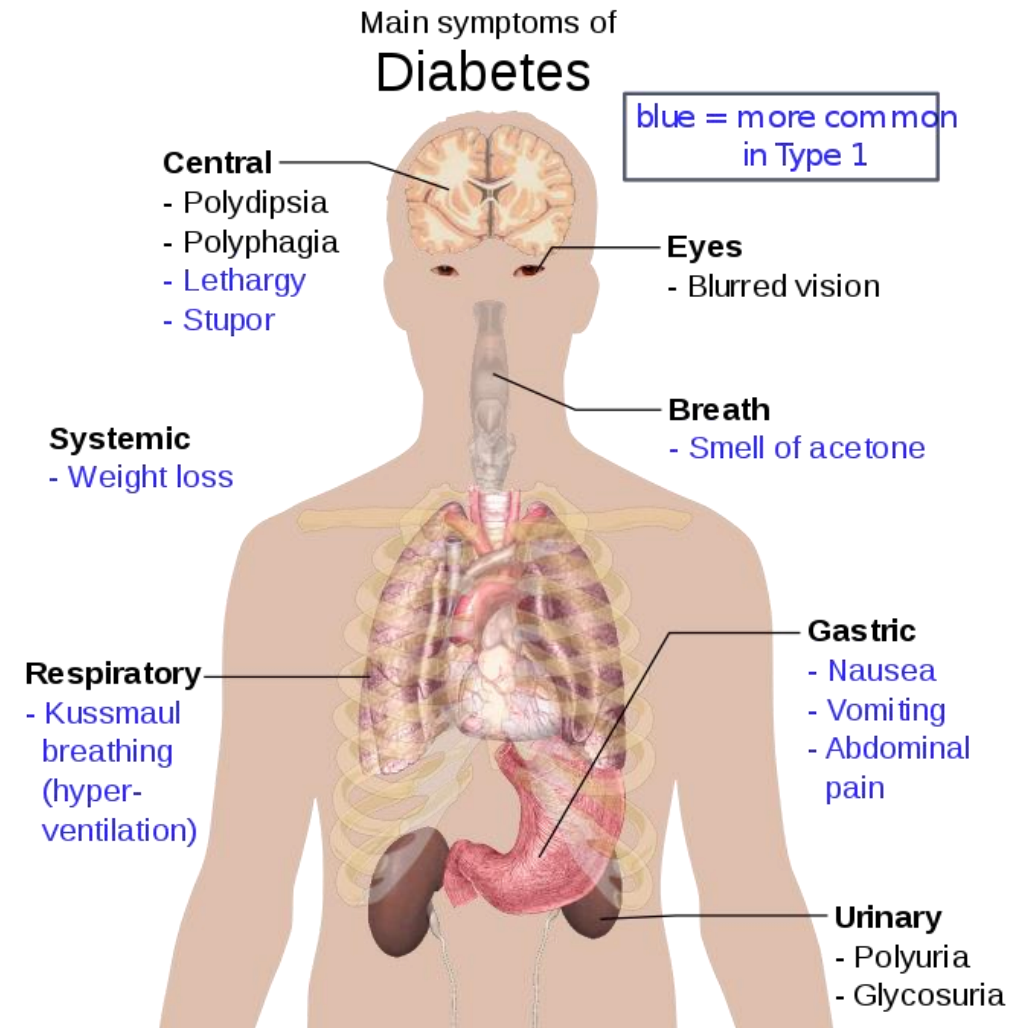


## Adapted plan



## › Use cases & value chains

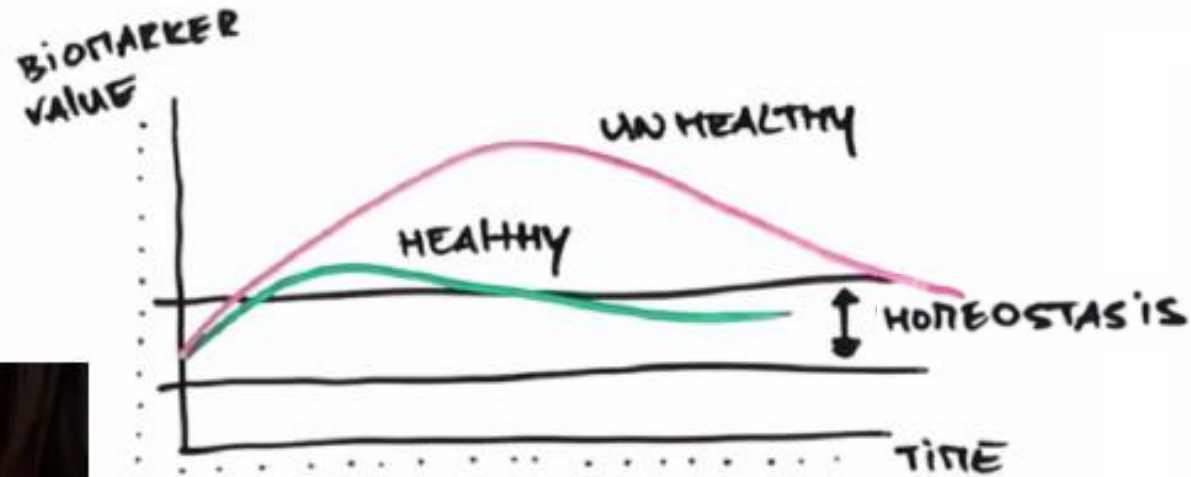
- Biomarkers for sub-typing of type 2 diabetes
- Prognostic (AI-based) models
- Health Care
  - SME Pharma serving (value-based)
- Consumer health
  - Upcoming market (SME)



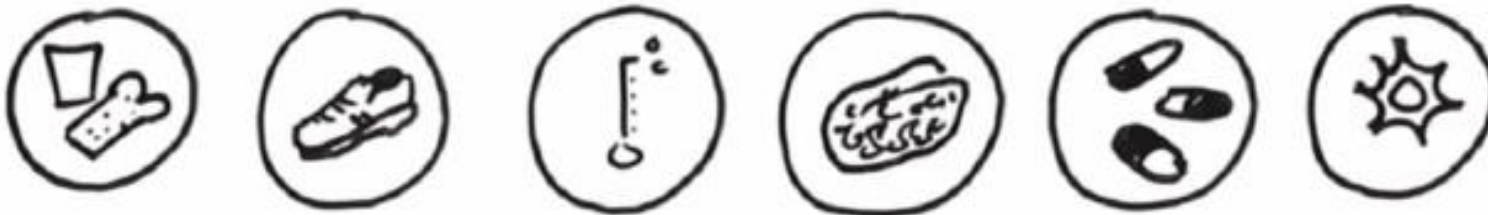
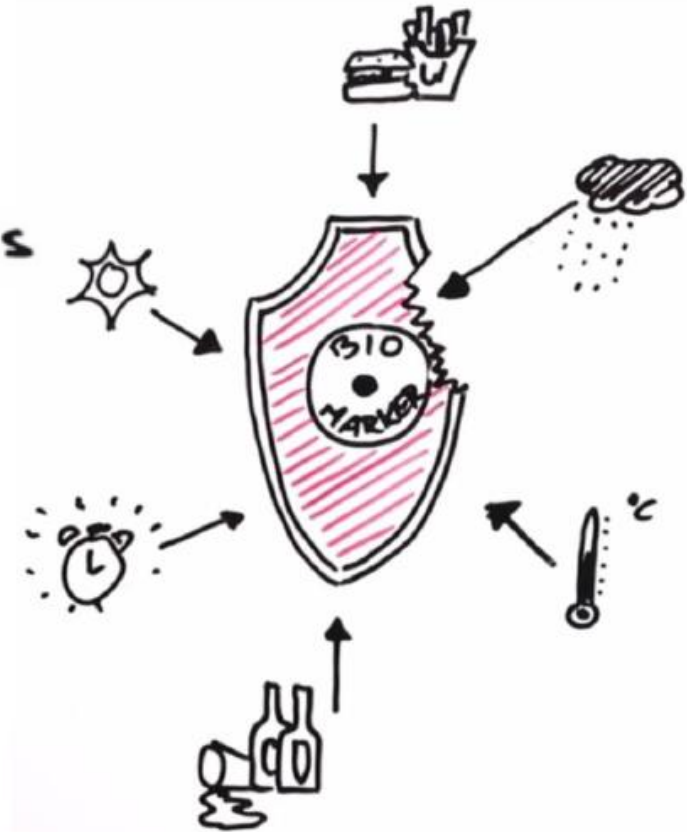
# Phenotypic flexibility: next generation health biomarker!



Fat  
Sugar  
Protein



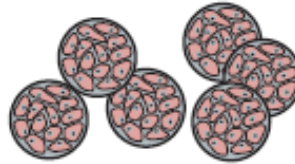
PHENOTYPIC FLEXIBILITY



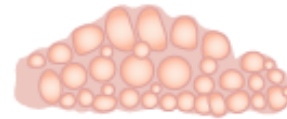


## Explanation of the subtypes

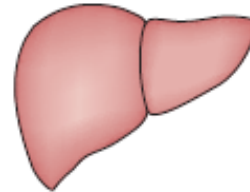
• $\beta$ -cell IR:  $\Delta\text{insulin (AUC 0-30)} / \Delta\text{glucose (AUC 0-30)}$



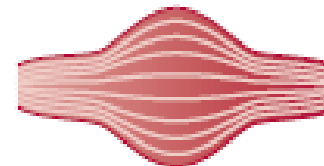
•Fat cell IR:  $\text{FPI} * \text{fasting NEFA}$



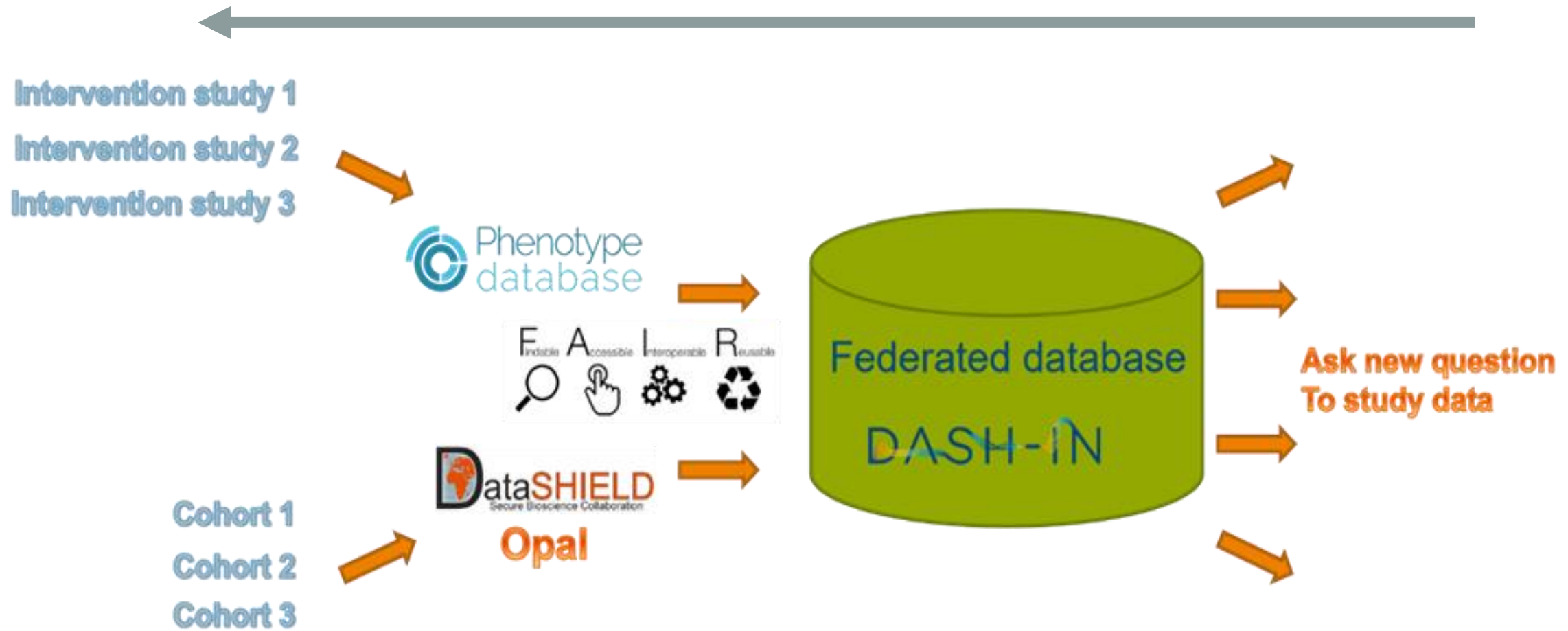
•Liver cell IR:  $\Delta\text{insulin (AUC 0-30)} * \Delta\text{glucose (AUC 0-30)}$



•Muscle cell IR:  $\text{dG/dt} \div \text{mean insulin (0-120)}$



## Adapted plan



# Current FAIRification of data

## Feature Mapper for ClinicalChem

Successfully added an external identifier to the Features in the list below.

<b>HDL</b>	<a href="http://purl.obolibrary.org/obo/CHEBI_39025">http://purl.obolibrary.org/obo/CHEBI_39025</a>
<b>LDL</b>	<a href="http://purl.obolibrary.org/obo/CHEBI_39026">http://purl.obolibrary.org/obo/CHEBI_39026</a>
<b>ALBUMIN</b>	TNO00001
<b>GLUCOSE</b>	<a href="http://purl.obolibrary.org/obo/CHEBI_17234">http://purl.obolibrary.org/obo/CHEBI_17234</a>
<b>FERRITIN</b>	<a href="http://purl.obolibrary.org/obo/CHEBI_82594">http://purl.obolibrary.org/obo/CHEBI_82594</a>
<b>PLP</b>	<a href="http://purl.obolibrary.org/obo/CHEBI_18405">http://purl.obolibrary.org/obo/CHEBI_18405</a>
<b>NEFA</b>	<a href="http://purl.bioontology.org/ontology/snmi/f-63002">http://purl.bioontology.org/ontology/snmi/f-63002</a>
<b>IL8</b>	<a href="http://purl.obolibrary.org/obo/CHEBI_138181">http://purl.obolibrary.org/obo/CHEBI_138181</a>
<b>VEGF</b>	TNO00003
<b>EGF</b>	<a href="http://purl.obolibrary.org/obo/CHEBI_140739">http://purl.obolibrary.org/obo/CHEBI_140739</a>
<b>Leptin</b>	<a href="http://purl.obolibrary.org/obo/CHEBI_81571">http://purl.obolibrary.org/obo/CHEBI_81571</a>
<b>Resistin</b>	<a href="http://purl.obolibrary.org/obo/CHEBI_81573">http://purl.obolibrary.org/obo/CHEBI_81573</a>
<b>C-Peptide</b>	<a href="http://purl.obolibrary.org/obo/CHEBI_80332">http://purl.obolibrary.org/obo/CHEBI_80332</a>
<b>Adiponectin</b>	<a href="http://purl.obolibrary.org/obo/CHEBI_81572">http://purl.obolibrary.org/obo/CHEBI_81572</a>
<b>INSULIN</b>	<a href="http://purl.obolibrary.org/obo/CHEBI_5931">http://purl.obolibrary.org/obo/CHEBI_5931</a>
<b>HOMA</b>	<a href="http://www.ebi.ac.uk/efo/efo_0004469">http://www.ebi.ac.uk/efo/efo_0004469</a>
<b>C15:0</b>	<a href="http://purl.obolibrary.org/obo/CHEBI_42504">http://purl.obolibrary.org/obo/CHEBI_42504</a>
<b>C17:1</b>	<a href="http://purl.obolibrary.org/obo/CHEBI_36001">http://purl.obolibrary.org/obo/CHEBI_36001</a>
<b>C20:2</b>	<a href="http://purl.obolibrary.org/obo/CHEBI_72850">http://purl.obolibrary.org/obo/CHEBI_72850</a>

## Ontologies: to be adapted

The screenshot displays the BioPortal website interface. The top navigation bar includes the BioPortal logo and links for Ontologies, Search, Annotator, Recommender, Mappings, and Resource Index. A 'Login' button and a 'Support' dropdown are also present.

The main content area shows the 'Diabetes Mellitus Diagnosis Ontology' (DDO) page. It indicates the ontology was last uploaded on December 23, 2015. Below this, there are icons for download, link, home, and a document icon.

A second browser window is overlaid on the first, showing the 'Diabetes Mellitus Treatment Ontology' (DMTO) page. This page was last uploaded on May 10, 2017. It features a 'Summary' tab and a 'Details' section. The 'Details' section includes a table with the following information:

Details	
Acronym	DMTO
Visibility	Public
Description	DMTO is an OWL 2 ontology for creating customized treatment plans for diabetic patients. The ontology is based on BFO and OGMS. In addition, it extends the DDO ontology by adding the treatment classes and axioms to the existing diagnosis part.
Status	Alpha
Format	OWL
Contact	3. Kyung-Sup Kwak , kskwak@inha.ac.kr 1. Shaker El-Sappagh , shaker_elsapagh@yahoo.com 2. Farman Ali , farmankanju@gmail.com

To the right of the 'Details' section is a 'Metrics' section with a table showing various statistics:

Metrics	
Classes	10,700
Individuals	63
Properties	315
Maximum depth	19
Maximum number of children	91
Average number of children	3
Classes with a single child	1,109
Classes with more than 25 children	31
Classes with no definition	10,477

On the left side of the DMTO page, there is a 'Submissions' section with a 'Version' table:

Version	
2015-11-20	(Archived)
1	(Archived)

Below the 'Submissions' section is a 'Views of DD' section, which is partially visible and shows 'No views of DD'.

## ENVIRONMENT & CONTEXT

### Medical history of obesity

*Age of onset of obesity*

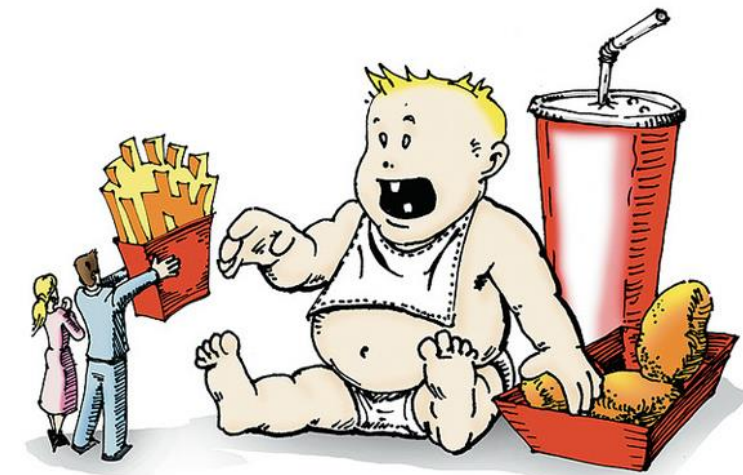
*Maximal and minimal body weight after 18 years of age*

*Variation of body weight during the past 3 months*

*Previous attempts to lose weight*

*Etiology of obesity*

*Parental obesity before conception and maternal bariatric surgery*





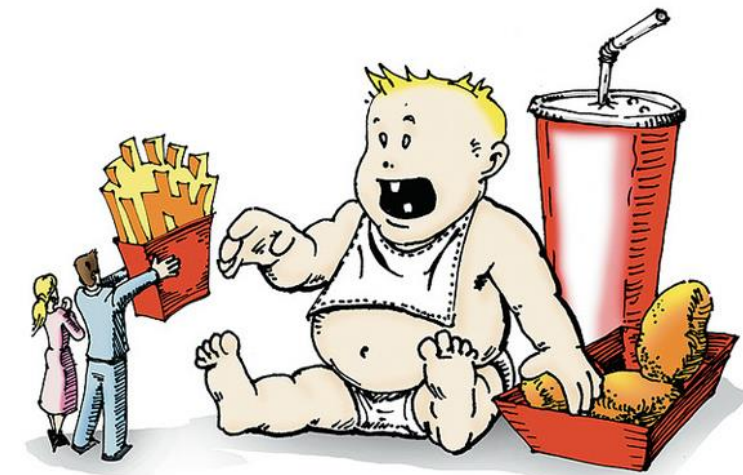
## ENVIRONMENT & CONTEXT

### Basic background information

*Number of years of education & country*

### Quality of life/handicap

*Quality of life (QoL: EQ-5D-5L)*



## › LIFESTYLE

### Dietary intake

*Dietary intake: EPIC-Norfolk FFQ or region-specific validated FFQ*

*Dietary quality: Dutch Healthy Diet index or region-specific validated index*



### Physical activity & sedentary behaviour

*Physical activity: PA levels via accelerometer*

*Sedentary behaviour: week day time and weekend day time via accelerometer; Paffenbarger Physical Activity Questionnaire*

*Physical fitness: Cardiorespiratory fitness (6-minute walk test) & muscle strength (Southampton grip-strength measurement)*

## › LIFESTYLE

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## › LIFESTYLE

### Sleep

*Sleep duration and timing: Custom questionnaire*

*Presence of sleep apnea: STOP-BANG*

### Stress and other psychological variables

*Perceived stress: PSS*

*Emotional eating: DEBQ*



## SUBJECT CHARACTERISTICS

### Anthropometry, body composition, and energy expenditure

*Weight and BMI*

*Anthropometry (waist, hip, neck)*

*Fat mass & fat-free mass using dual energy X-ray absorptiometry (DXA)*





## COMORBIDITIES

### Diabetes

*Fasting glycemia (two measurements)*

*Hemoglobin A1c*

*Fasting insulin and insulin-derived insulin sensitivity indices*

*Family history of diabetes: Custom questionnaire*

### Cardiovascular disease

*Blood pressure & heart rate*

*Total cholesterol, HDL cholesterol, triglyceride*

*CRP*

*1-5 min ECG*

*6-minute walk test*

*Smoking habits: Custom questionnaire*



## COMORBIDITIES

### Hormonal status

*Thyroid stimulating hormone*

*Menopausal status (in females), current medications: Custom questionnaire*

### Liver disease

*NFS and FIB-4: ALT, AST, GGT, platelet count, and albumin from blood*



## HOW TO HANDLE THE OGTT

What is the definition of a OGTT?

What to do with 50g, 75g, 100g?

The screenshot shows the BioPortal website interface. The browser address bar displays the URL: [https://bioportal.bioontology.org/ontologies/DDO?p=classes&conceptid=http%3A%2F%2Fpurl.obolibrary.org/obo/DDO\\_0000246](https://bioportal.bioontology.org/ontologies/DDO?p=classes&conceptid=http%3A%2F%2Fpurl.obolibrary.org/obo/DDO_0000246). The BioPortal logo is in the top left, and navigation links (Ontologies, Search, Annotator, Recommender, Mappings, Resource Index) are in the top center. A 'Login' button and 'Support' link are in the top right. The main heading is 'Diabetes Mellitus Diagnosis Ontology' with a subtext 'Last uploaded: December 23, 2015'. Below the heading are tabs for 'Summary', 'Classes', 'Properties', 'Notes', 'Mappings', and 'Widgets'. The 'Classes' tab is selected. On the left, a tree view shows the ontology structure: 'entity' (continuant, occurrent, process) and 'process' (bodily process, clinical history taking, convalescence, diagnostic process, disease course, etiological process, health care process, history, inflammation process, laboratory test, diabetes laboratory test). On the right, the 'Details' tab is selected, showing a table of properties for the class 'OGTT'.

Property	Value
Preferred Name	OGTT
Definitions	Oral glucose tolerance test
ID	<a href="http://purl.obolibrary.org/obo/DDO.owl#DDO_0000246">http://purl.obolibrary.org/obo/DDO.owl#DDO_0000246</a>
definition	Oral glucose tolerance test
label	OGTT
prefixIRI	DDO:DDO_0000246
prefLabel	OGTT
snomed ct concept ID	113076002

## › WHAT ARE THE MISSINGS AND LIMITATIONS OF THE INFRASTRUCTURE?

How to handle the interoperability issue if using Datashield

## › NEXT PERIOD: IMPLEMENTATION AND ROLLOUT

Implementation of the subtyping script in R packaging solution

Test of usability

Extend/develop ontology for personal health data

The screenshot shows the BioPortal website interface. The browser address bar displays the URL: <https://bioportal.bioontology.org/ontologies/CWD?p=classes>. The BioPortal logo is in the top left, and navigation links (Ontologies, Search, Annotator, Recommender, Mappings, Resource Index) are in the top center. A 'Login' button and 'Support' link are in the top right. The main content area is titled 'Consumer Wearable Device' with a subtitle 'Last uploaded: April 19, 2018'. Below the title are icons for download, link, and home. A tabbed interface shows 'Summary', 'Classes', 'Properties', 'Notes', 'Mappings', and 'Widgets'. The 'Classes' tab is active, showing a list of classes under 'Jump to:'. The 'Details' tab is also visible, showing a table of class details for '3axisAccelerometer'.

Details	
Preferred Name	3axisAccelerometer
ID	<a href="http://www.semanticweb.org/jbagwell/ontologies/2017/9/untitled-ontology-6#3axisAccelerometer">http://www.semanticweb.org/jbagwell/ontologies/2017/9/untitled-ontology-6#3axisAccelerometer</a>
prefixIRI	axisAccelerometer
prefLabel	3axisAccelerometer
subClassOf	<a href="http://www.w3.org/2002/07/owl#Thing">http://www.w3.org/2002/07/owl#Thing</a>



## › DEMO

Which Databases are connected → all datasets in the Phenotype database can be search for individual parameters, such as Igucose and insulin

How was data integrated → Now all analysis can be done directly in R

Demo of research queries → Direct calculation of insulin subtypes for all (accessible) studies

Demo how external parties could make use of the demo (see deliverable in the comments) → show how to make a account in the Phenotype database

Thank you

