



Leipzig Research Center  
for Civilization Diseases

UNIVERSITÄT LEIPZIG

Faculty of Medicine

# The Leipzig LIFE-Biobank

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Clinical Chemistry and Molecular Diagnostics  
University Hospital Leipzig

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4. Nationales Biobanken-Symposium, Berlin  
09.12.2015

# Leipzig Research Center of Civilization Diseases „LIFE“



**Start 2009: 24.000 study participants (final 2014)**

**Speakers: Joachim Thiery , Markus Löffler**

## (A) LIFE HEALTH

**ADULTS and CHILDREN** (Leipzig population based study)  
(adults: N = 10000, children: N = 6000 ( incl. 1000 newborns))

## (B) LIFE DISEASES

- Main Clinical Phenotypes (N = 8000)
- Diabetes/Adipositas
  - Disorders of Lipid Metabolism
  - Vascular diseases
  - Depression
  - Cognitive Impairment
  - Allergies
  - Macula Degeneration
  - **Heart diseases (LE HEART Study)**
  - **Cancer/Inflammation**

## (C) LIFE-ANALYSIS

MRI (brain/abdomen), EEC, ECG, Echocardiography, Carotis ultrasound, clinical chemical tests, X-omics, **Cryo-biobank**, bioinformatics and genetic statistics

## (D) LIFE-TRANSFER

Function, diagnostics transfer, novel treatment targets.

Which genetic and environmental factors cause the individual variance of modern diseases?



Europa fördert Sachsen.  
**EFRE**  
Europäischer Fonds für  
regionale Entwicklung

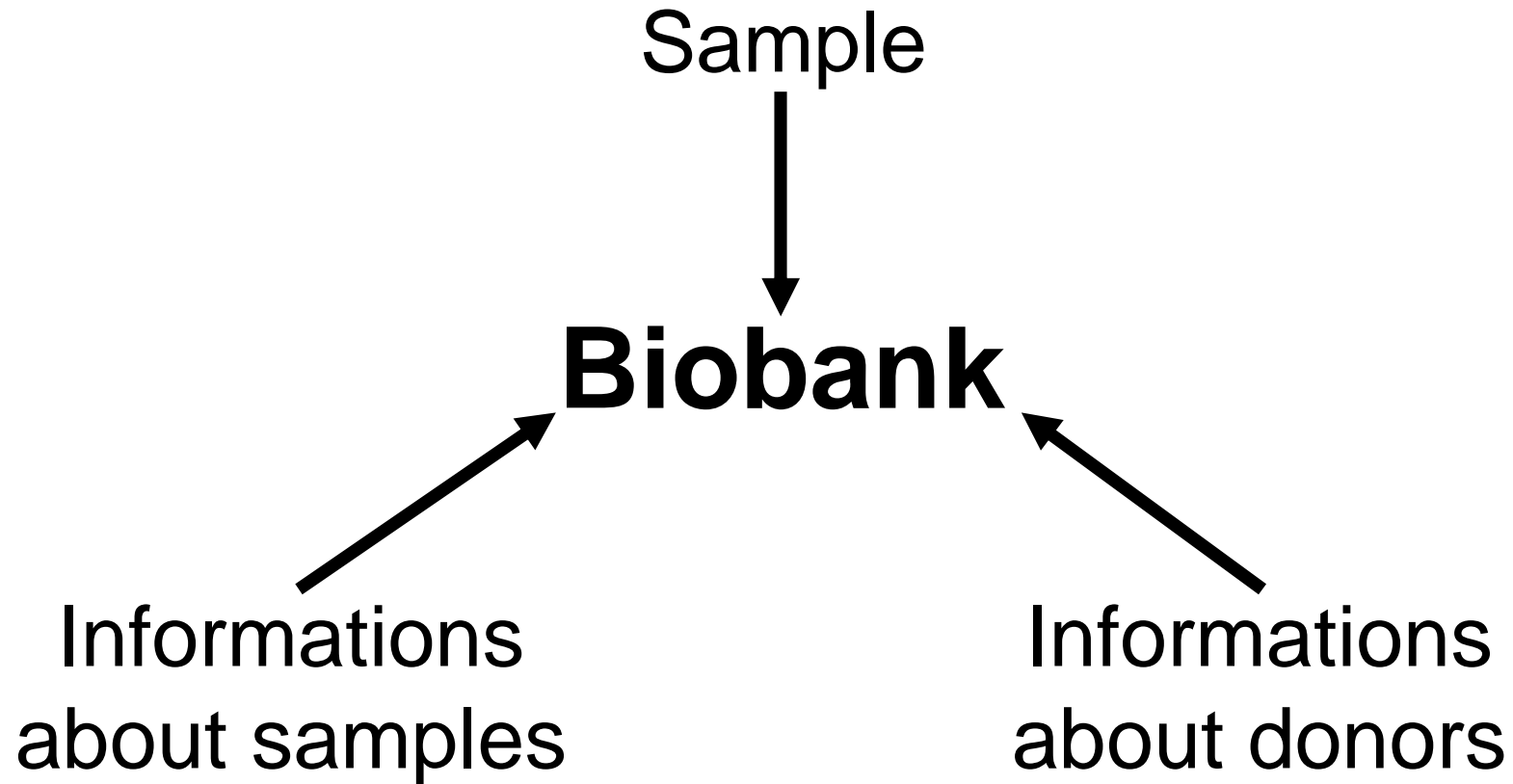
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**ESF**  
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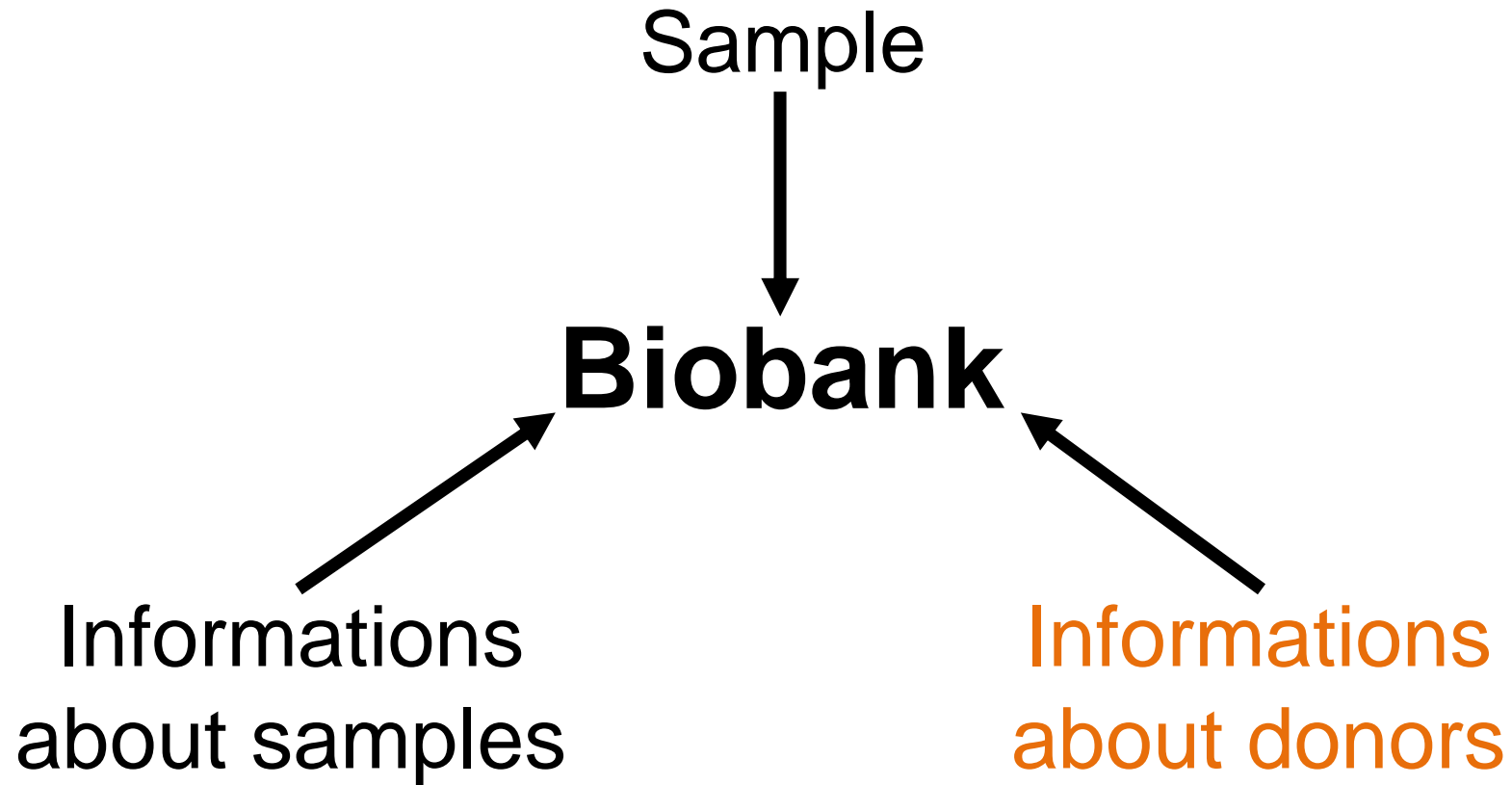




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Physical and medical examinations

Interviews and questionnaires



Examination	Sample
<b>Bio-specimen asservation</b>	
Serum, plasma, lymphocytes for DNA, RNA, urine	>9900
<b>Anthropometry</b>	
Classical: Body weight, body height, circumference measures	>9900
3D laser based optical body surface scan	>9800
MRI based abdominal fat tissue volumetry	>1000
<b>Cardiovascular system</b>	
Blood pressure	>9900
Electrocardiography (10 s, 12 leads)	>9700
Echocardiography	>8300
Carotid ultrasound	>9600
Ankle-brachial index (ABI), pulse wave velocity (PWV)	>9200
.....	

**Table 3** Computer- assisted personal interviews (I), self-administered questionnaires (Q) and cognitive tests (T)

Assessment	Type	Target population (age)
<b>Socio-demographics and medical history</b>		
Socio-demographics and socio-economic status	I	18-79
Medical history	I	18-79
Family medical history	I	18-79
Medication (last 7 days)	I	18-79
Allergies	I	18-79
<b>Cognition</b>		
Stroop test	T	18-79
Trail-Making Test A&B	T	18-79
Subjective Memory Impairment	I	18-79
Verbal Fluency Test 'Animals'	T	18-79
Behavioral Assessment of the dysexecutive syndrome (DEX)	Q	18-79
Triangle test	T	60-79
Reading the mind in the eyes test	T	60-79
.....		

data from DQP



**LIFE-Scientific-Database:**  
Virtual apothecary cabinet:  
to date approx. 20 million data sets

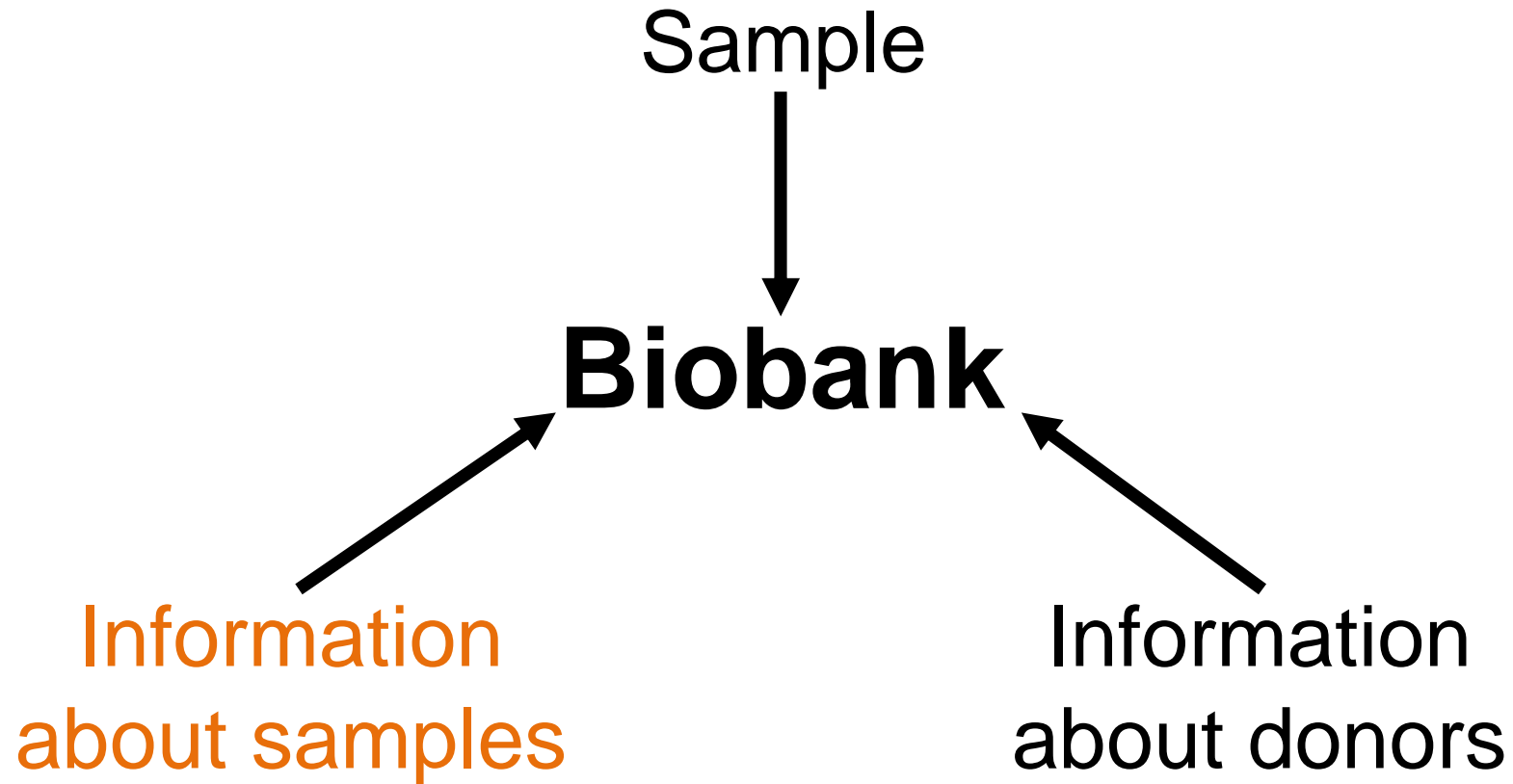
BMC Public Health 2015



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# LIFE - Laboratory information management system = CryoLab

Ambulance Management

Preamanalytical Management

The screenshot displays the LIFE CryoLab interface with several panels:

- Navigation:** A sidebar menu on the left with categories like Mandanten, Stammdaten, Kohorten, etc.
- Entnahmen:** A table listing sample extractions with columns for Datum, SIC, Entnahmer, and Profil.
- Details der Entnahmen A120V5:** A detailed view of a specific extraction, showing material numbers, tubes, and fill status.
- Neueste Kommentare:** A list of recent comments on the right side.
- Kücher (10):** A table at the bottom showing vials with columns for Küchennummer, RBR, and Lagerplatz.

CryoLab

Sample Management

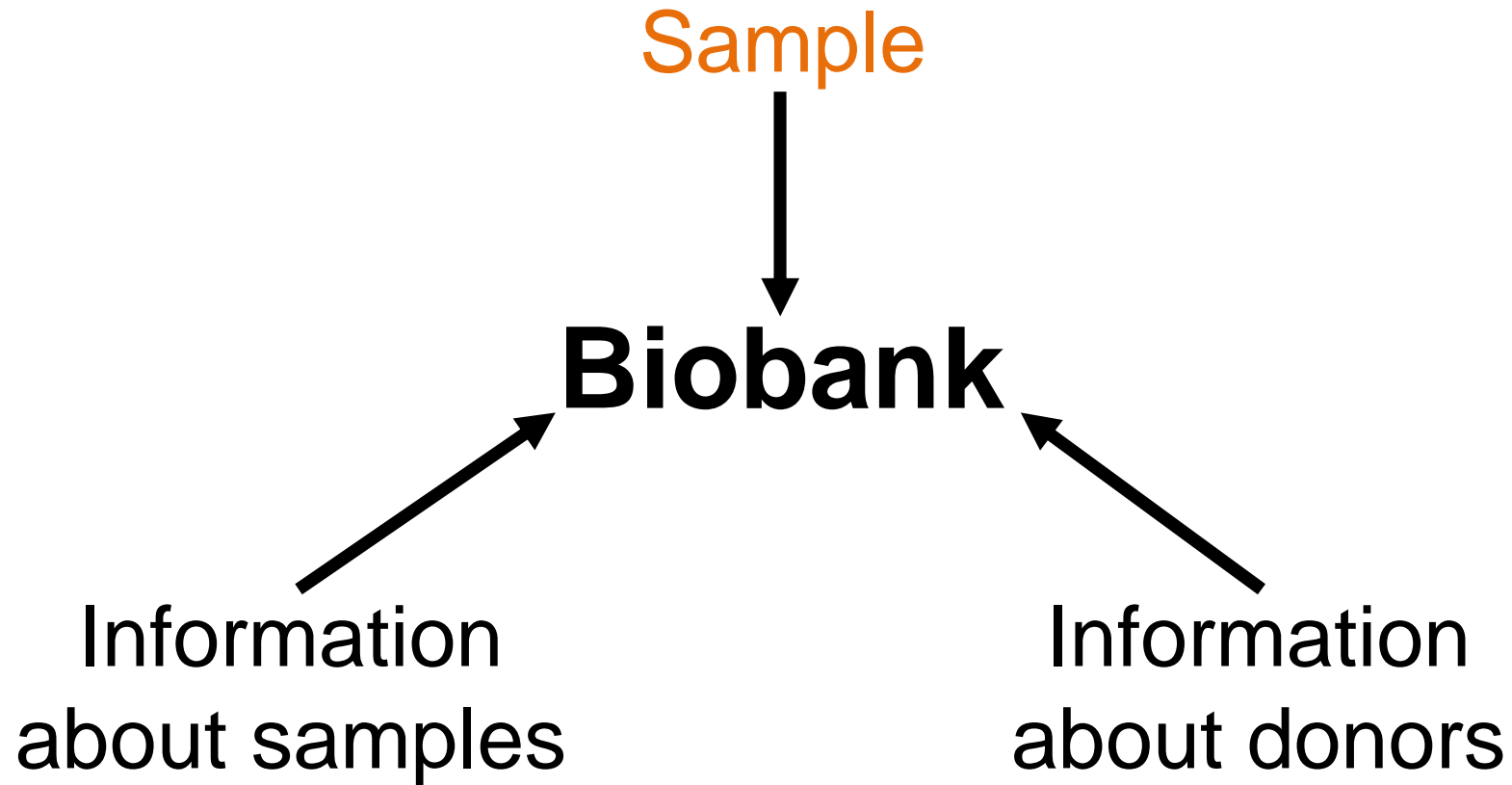
Biobank Management



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**LIFE population cohorts**  
(adults + children)  
16.000

**LIFE disease based cohorts**  
(Heart, depression, obesity,  
dementia, allergy, cancer)  
8.000

**LIFE preanalytical lab**

identification  
↓  
centrifugation  
↓  
cloning



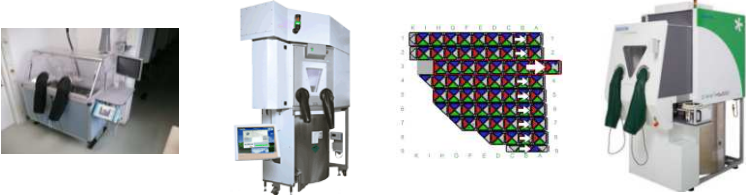
**Clinical Laboratory (ILM)**  
**Analysis of 83 blood and urinary biomarkers**  
**(same day)**

Isolation of peripheral blood mononuclear cells


Isolation of DNA from buffy coat/whole blood

Isolation of RNA from tempus tubes

**Biobank N<sub>2</sub> (< - 150 °C)**



**Biobank - 80 °C**



Metabolomics

Proteomics

Clinical Chemistry

Genomics


Transcriptomics

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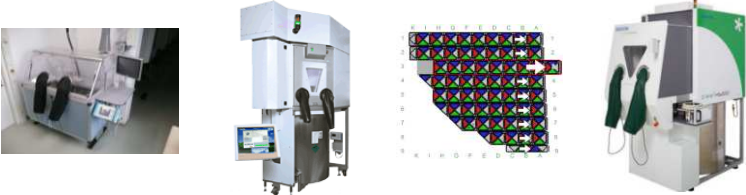
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### LIFE Cohorts

### Direct Laboratory Analysis (ILM)

- >70 Blood and Urine Biomarkers
- 63 Metabolites (LC-MS/MS)

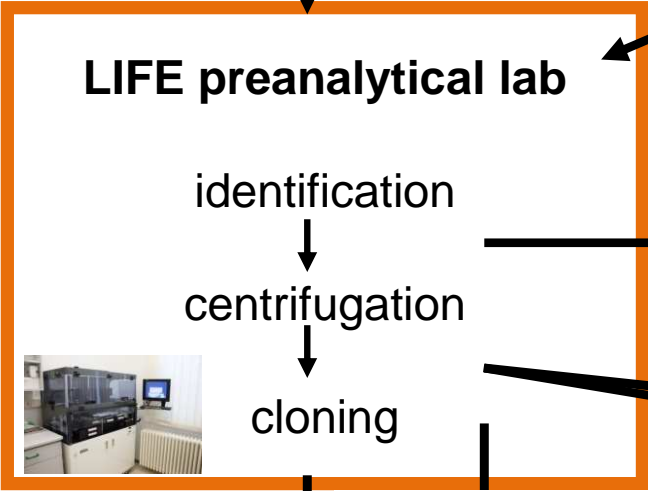


**Institute of Laboratory Medicine (ILM)**  
**University Hospital Leipzig**  
**(Prof. Dr. J. Thiery)**

SERUM	SERUM	SERUM
<b>Elektrolytes</b>	<b>Glucose metabolism</b>	<b>Inflammation</b>
Sodium	Glucose	CRP (high sensitive)
Potassium	C-Peptide	IL-6
Chloride	Insulin	<b>Autoimmunity / Allergy</b>
Magnesium, (Ca,Cl,PO4)		SX1
<b>Liver / Pancreas</b>	<b>Iron metabolism</b>	FX5
Alanine aminotransferase (ALAT)	Transferrin	IgE (total)
Aspartate aminotransferase (ASAT)	Ferritin	
Gamma-glutamyl transferase	<b>Vitamins</b>	<b>EDTA WHOLE BLOOD</b>
Cholinesterase (CHE)	Folic Acid	
Glutamate dehydrogenase GLDH)	Vitamin B12, (Vit. D3)	<b>Hematology</b>
Lactat dehydrogenase (LDH)	<b>Bones and Joint</b>	Blood count / Hemogram
Bilirubin (total)	Alkaline phosphatase (ALP)	Erythrocytes
Bilirubin (direct)	Calcium	Thrombocytes
Bilirubin (indirect)	Phosphat	Lymphocytes
Lipase	Osteocalcin	Reticulocytes
Albumin	β-CTX	Erythrocyte indices
Protein (total), (ALP)	Procollagen type 1 (P1NP)	
<b>Renal</b>	PTH	Hemoglobin A1c (G)
Creatinin	25-OH-Vit.D3 (Calcidiol)	
Urea	<b>Steroids and Sex Hormons</b>	<b>Metabolome Profil (n=63)</b>
Cystatin C	Cortisol	26 Amino acids
Uric acid	LH	37 Acyl carnitines
<b>Heart</b>	FSH	
Creatin Kinase (CK, CK-MB)	Estradiol	
Myoglobin	Testosterone	
Troponin-T (high sensitive)	SHGB	
NT-proBNP	DHEAS-S	
<b>Lipid Metabolism</b>	<b>Thyroid Hormons</b>	<b>URINE</b>
Cholesterol	ft3	
HDL cholesterol	ft4	<b>Kidney function</b>
LDL cholesterol	Thyroglobulin antibodies	Albumin
Apo B	Thyreoidperoxidase antibodies	Creatinin
Apo A1	TSH receptor antibodies	IgG (total)
Triglycerides	TSH	Protein (total)

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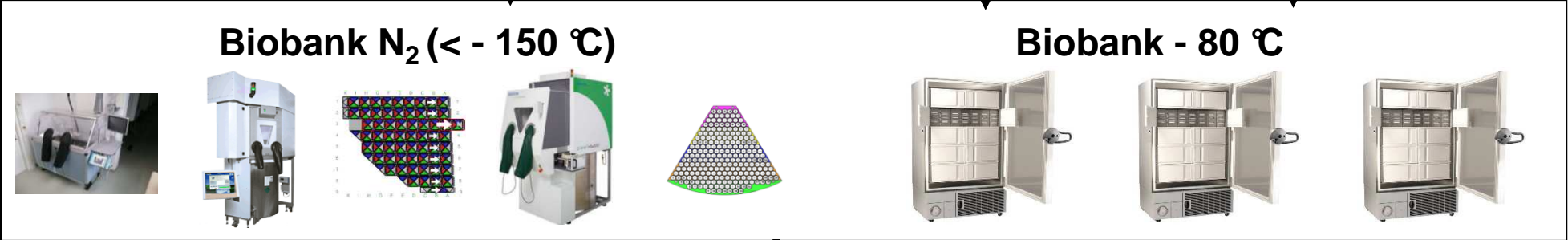


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### Blood taking (4 - 90 ml, depending on the cohort)





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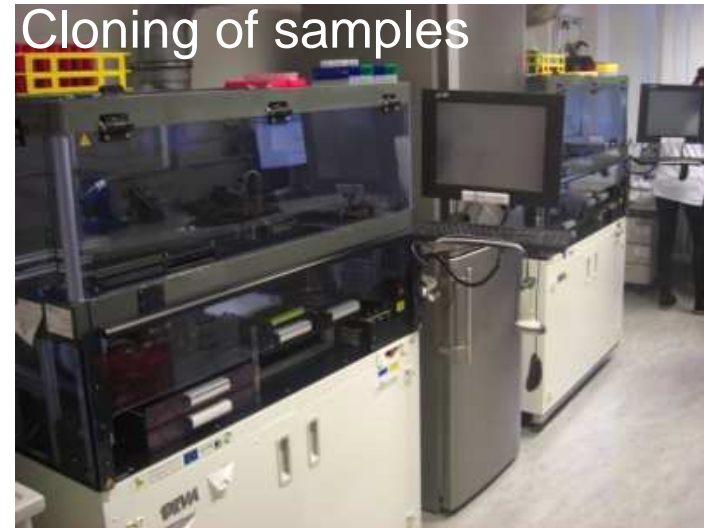
**Blood taking**



Preanalytic clinical laboratory



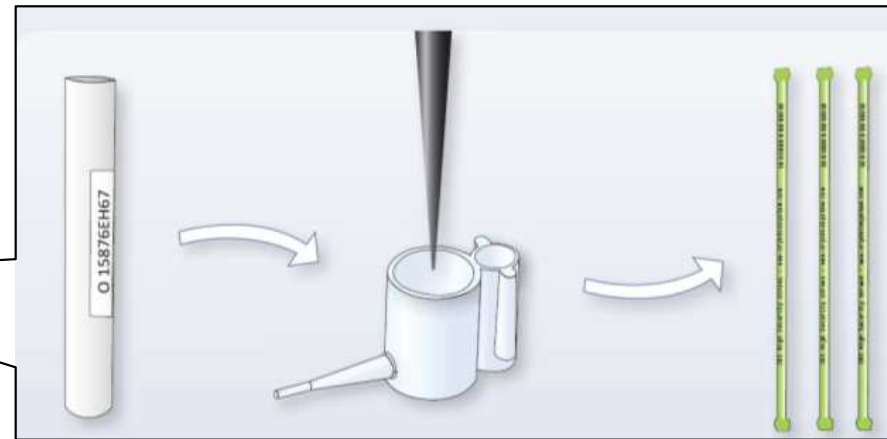
Cloning of samples



Storage in Cryobiobank



# Automatized Cloning of Samples in Sealed Straws



**Straws produced by DIVA**  
**→ Hermetical sealed**  
**→ Barcoded**




Cryobiosystems, Paris

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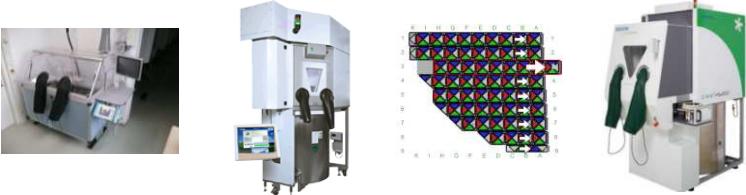
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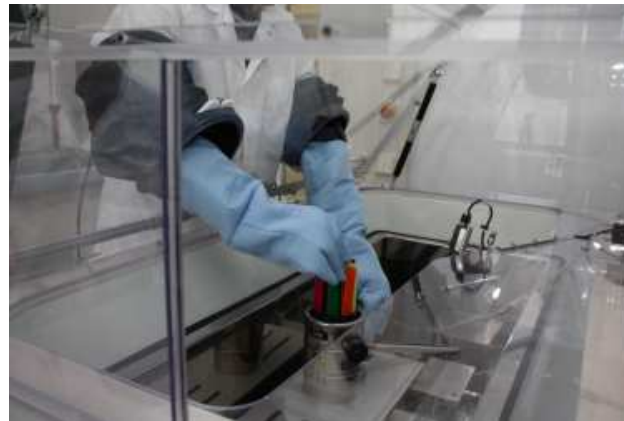
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# Biobank workflow

### Temporary Freezer

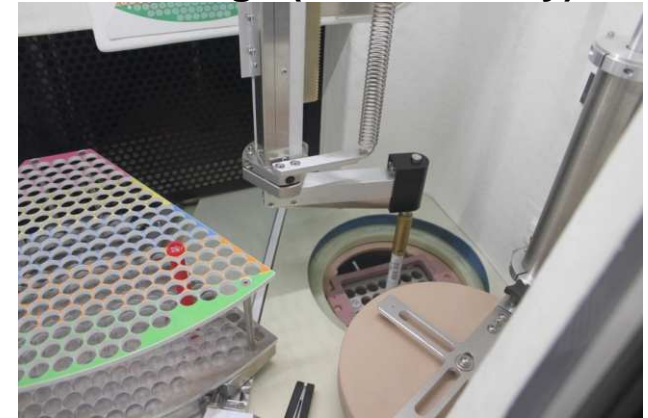


### Sorting



20 min for 700 samples

### Storage (automatically)



8 min for 300 samples

## Consistent cooling chain



### Transport (dry ice)



### Channel in



### Storage (manually)



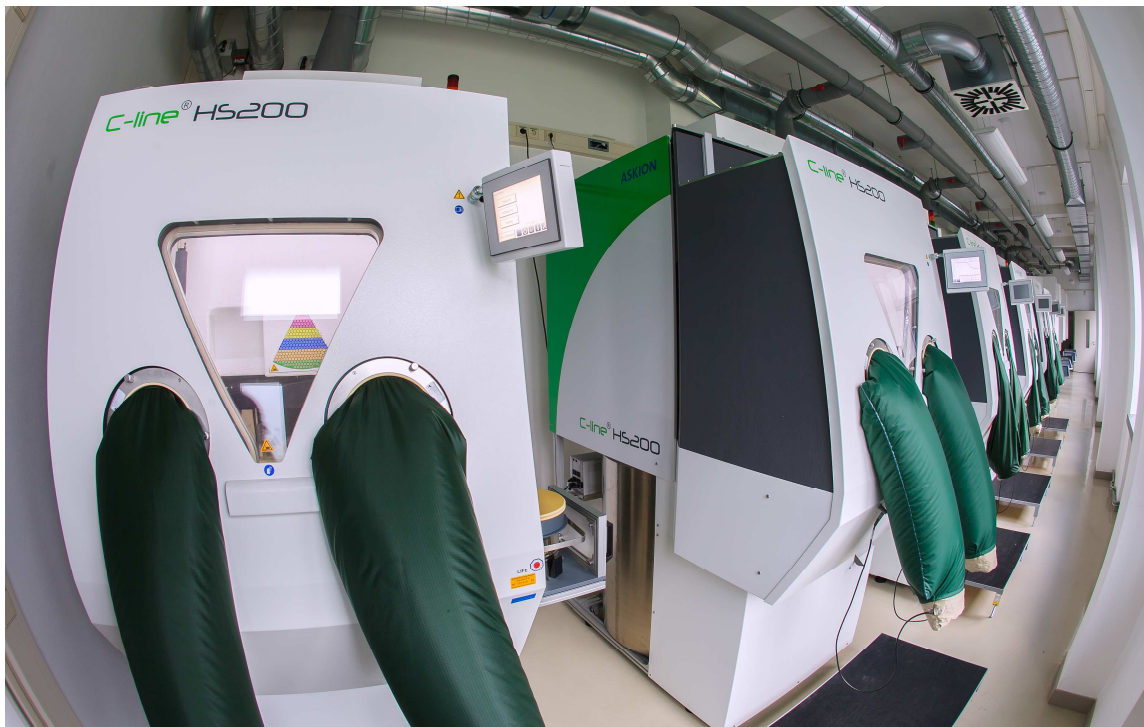
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## Cryobiobank storage

Capacities of the LIFE-Biobank (gas phase of N<sub>2</sub>, < -150°C)



<b>Straws</b>	<b>790.000</b>
<b>Tissue tubes</b>	<b>21.120</b>
<b>Cryo tubes</b>	<b>24.500</b>
	<b>835.620</b>

# Biological samples from study participants

	- 80 C°	< - 150 °C
Serum	X	X
Plasma (ETDA, Citrate, Li-Hep)		X
Urine	X	
Breast milk	X	
Dried blood spot cards	X	
DNA/RNA	X	
Peripheral mononuclear blood cells		X
Stabilized whole blood	X	
Saliva	X	
Stool	X	

also hair at room temperature





### Balance of biobank samples

Samples in

400.000



Samples out

67.000



580.000



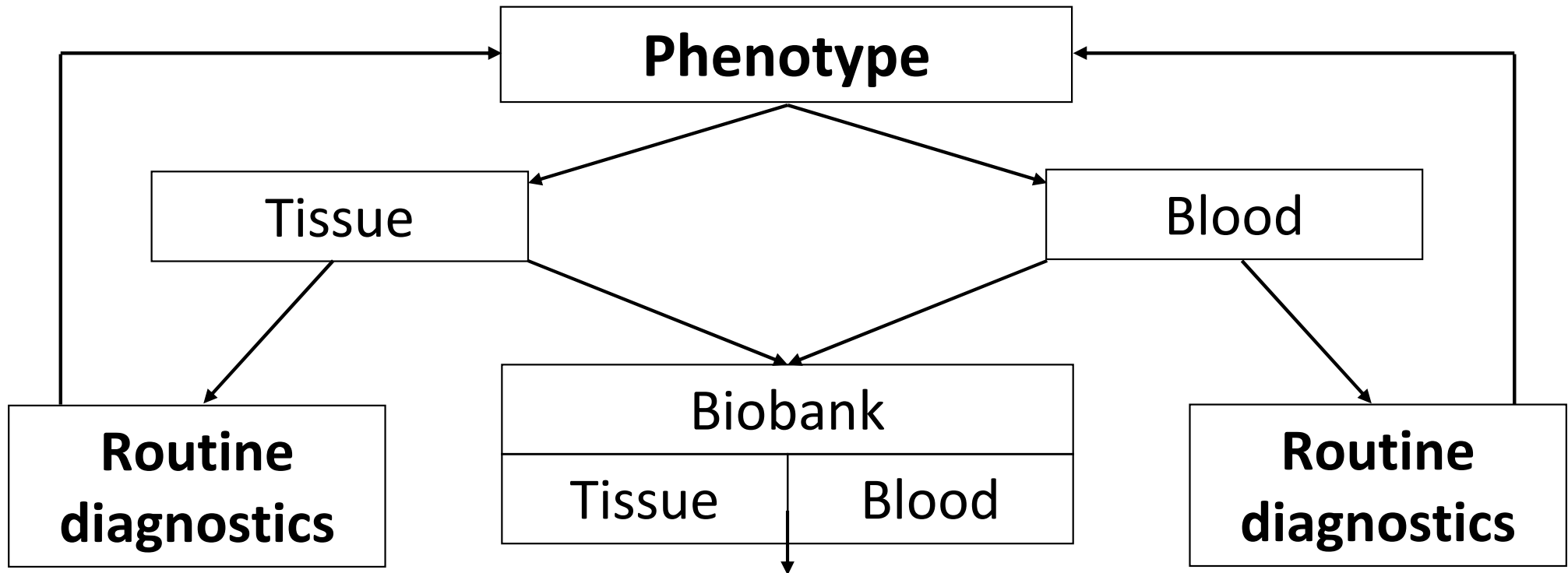
10.000



41 Studies



### Next Step → Phenotype based Biobank



Special diagnostics:

- genome wide genotyping
- genome wide expression analysis
- metabolomic analysis from dried blood cards



## Conclusion

- **24000 study participants recruited**
- **extensive phenotyping programm with more than 20 million datasets (including direct laboratory analysis, genome wide genotyping, transcriptomic analysis)**
- **up to 50 aliquots per participant (straws + cryotubes)**
- **around 1 million samples collected → monitoring of sample processing time for each aliquot**
- **320 projects in total (41 using biomaterial from the biobank)**
- **next step is to transfer the epidemiological biobank into a phenotype based biobank**



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### Thanks to:

Professor Dr. Joachim Thiery  
Professor Dr. Uta Ceglarek  
Dr. Julia Stäker

Dr. Matthias Nüchter  
Alexander Kiel

Professor Dr. Daniel Teupser  
Dr. Johannes Zander

LIFE preanalytical lab and  
biobank team:

Birgit Ronneberger  
Gabriela Härtel  
Kristin Kolbe  
Juliane Garbrecht  
Britt Rosin  
Angelina Nietzsche



Funded by:



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**Thank you for your attention!**

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